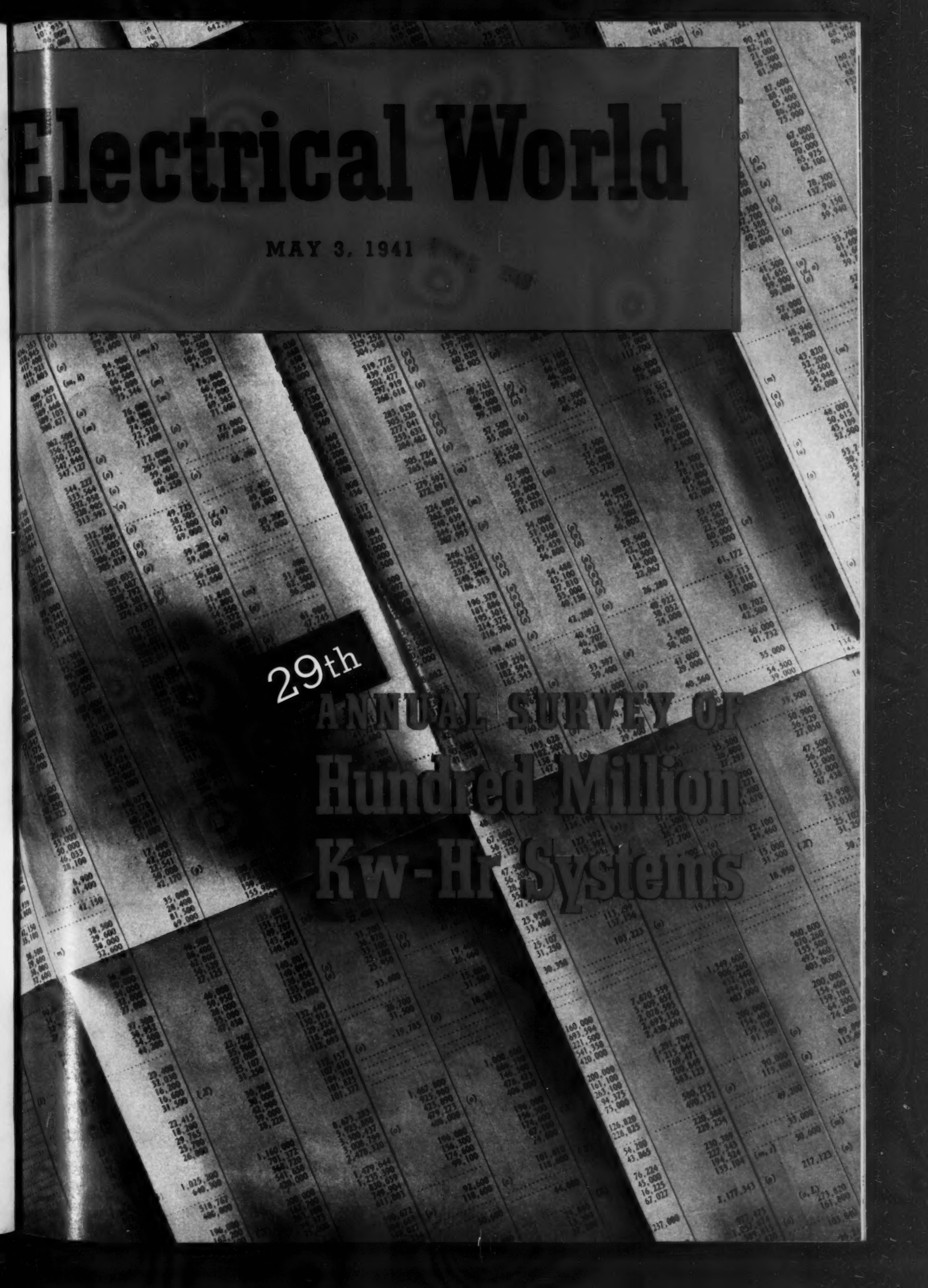

Electrical World

MAY 3, 1941

29th

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May 3, 1941

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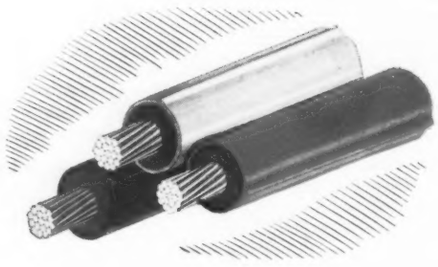

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The Home of the Brave

America, the land of the free and the home of the brave. Yes, compared with a large part of the rest of the world, America is the home of freedom, yet compared with the America we used to know it is becoming a home of fear. Legally men are as free to express themselves as they ever were, but actually they dare not more and more.

Ever since the New Deal started hammering away at the electric utility industry, fear has been getting stronger. Our to-be-destroyed-upon-receipt correspondence is growing. Executives hesitate to talk at public meetings. Adverse decisions of federal agencies are accepted with a shrug. Companies have resigned from associations.

Whence comes this fear? This fear comes from fear—fear of retaliation, fear of punitive regulation, fear of hordes of government employees swarming all over one's place of business, fear that our Supreme Court can no longer be relied on to mete out impartial justice.

All this is real, in spite of the fact that we live in the home of the free. But America is also supposed to be the home of the brave. Bravery sometimes consists in fighting a rear-guard action to cover a retreat, and so permit the main body to strengthen its position. But bravery that wins finally consists in taking the offensive.

Today government ownership is being concentrated in a single division of the Department of the Interior. This means unified direction, centralized organization. At the same time organization within the utility industry is disintegrating. One by one holding companies that represented a certain kind of centralization are breaking up into parts. Resignations from the one association that could hold the industry together have weakened its representation.

Government ownership today has a leader. Private ownership has no leader whom the industry will follow.

The leader of the government ownership program will press the attack relentlessly and ruthlessly. When the time comes to enter any particular area it will be too late to set up a defense. The time to fight is now and the best weapon is a good preparation.

From past experience it is known that attacks take several forms: Rates, political pressure, propaganda, skeleton baring. To meet it utilities must put their houses in order. If there are any skeletons, take them out and bury them, or else bring them to light so they may no longer haunt one.

If there are any parts of the corporate organization, no matter how long they have been in the family or how much they may have cost at one time, that are a burden to the electric side in preventing it from establishing lower rates, they should be abandoned.

If there are any pet practices or policies or services that cannot be justified in a competitive rate they should be swept away now, and not wait until the attack comes. Too often have utilities made concessions under fire that served merely to corroborate the statements of their adversaries.

To do that will require real management courage. If any executives have lost the will to fight, or are too afraid to fight, or are incapable of fighting, they should give way to others.

Even if America is no longer the home of the free for the utilities, it can still be the home of the brave.

Annual Peak Load Survey Reaffirms Utility Preparedness

Supplement to this issue lists operating data for 186 major public utility systems in North America—Higher utilization, load and plant factors are shown for United States utilities

CHARLES DE VORE, Assistant Editor

AVERAGE utilization factor for the major electric utilities in the United States rose to a new level of 78.5 per cent in 1940, as compared with 75.4 per cent in 1939. National utility plant factor advanced to a new high of 41.9 per cent, as against 38.7 in the previous year. Combined load factor for thirty of the largest companies was improved from 54.5 to 55.7 per cent, but was still below the 1937 mark of 57.8 per cent.

These evidences of bettered performance are shown in ELECTRICAL WORLD's 29th annual survey of 100,000,000-kw.-hr. systems, which includes 186 public utility systems in North America, a record number. Of these 186 companies, 155 are light and power companies in the United States, seventeen are electric utilities operating in Canada, one is a Mexican system and the remaining thirteen are electric railways and railroads. Despite rapid increase in energy demand due to growing defense industrial loads, demonstrated utility "preparedness to serve," plus planned capacity additions, reaffirms the unlikelihood of any power shortage due to load increases.

Utilization Factors Higher

Of the 155 utilities in this country, 137 included data from which utilization factors (ratio of generator peak to generator capacity) could be calculated. Combined capacity of these 137 companies was 89 per cent of the United States total in this year's annual study. For the individual companies, as shown on an accompanying chart, utilization factors varied from 42.7 to 127.5 per cent, with a median value of 78.3 per cent. In 1939 the range was from 22.2 to 123.2 per cent and the median was 74.5 per cent.

Last year twenty companies (1,581,841 kw.), against seventeen in 1939, had utilization factors above 100 per cent (Table III).

In 1940, 62 companies, accounting for 44 per cent of the total capacity in Table III, had utilization factors of 80 per cent or more. The corresponding figures for 1939 were 53 companies and 35 per cent of the capacity. Last year 22 companies with 7 per cent of the total capacity had utilization factors under 60 per cent. This compared with 21 companies and 8 per cent of the capacity in 1939. Thus, for 1940, 53 companies, representing 49 per cent of the capacity, had utilization factors in the 60 to 80 per cent range. For 1939 there were 57 companies with 57 per cent of the capacity in that range.

Regional utilization factors in 1940 varied from 86.5 per cent in the Mountain states to 67.8 per cent in the West North Central (Table IV). For the country as a whole, non-coincident peaks increased about 11.9 per

Table III—Generator Capacities Grouped by Utilization Factors

Utilization Factor, Per Cent	Number of Systems	Generator Capacity, Kw.
100 and more..	20	1,581,841
90 to 99.9....	19	3,481,042
85 to 89.9....	9	2,917,925
80 to 84.9....	14	6,168,191
75 to 79.9....	18	6,668,413
70 to 74.9....	18	4,058,461
65 to 69.9....	10	3,509,877
60 to 64.9....	7	960,900
50 to 59.9....	15	1,581,778
Less than 50..	7	753,668
Total.....	137	31,682,096

Table IV—Comparison of Generator Capacity and Aggregate Generator Peaks, by Regions

Region	1940			1939		
	Capacity Reported, Kw.	Aggregate Peaks, Kw.	Ratio, %	Capacity Reported, Kw.	Aggregate Peaks, Kw.	Ratio, %
New England.....	2,469,283	1,823,609	73.9	2,239,025	1,632,284	72.9
Middle Atlantic....	9,453,021	7,381,935	78.1	9,229,111	6,942,447	75.2
E. North Central...	7,264,802	5,732,552	78.9	6,717,474	5,104,373	76.0
W. North Central..	2,618,756	1,776,386	67.8	2,414,736	1,589,718	65.8
South Atlantic.....	1,740,378	1,493,367	85.8	1,618,253	1,360,128	84.0
E. South Central...	1,257,925	1,049,400	83.4	1,763,963	1,332,390	75.5
W. South Central..	1,789,888	1,369,742	76.5	1,669,590	1,265,511	75.8
Mountain.....	1,682,366	1,454,896	86.5	1,574,869	1,255,560	79.7
Pacific.....	3,404,677	2,798,839	82.2	2,285,054	1,757,290	76.9
United States.....	31,682,096	24,880,726	78.5	29,512,075	22,239,701	75.4

cent over 1939 to 24,880,726 kw., and capacity about 7.4 per cent to 31,682,096 kw., giving a ratio of peak to capacity of 78.5 per cent. In 1939, as compared with 1938, non-coincident peaks increased about 13 per cent, with a rise in generator capacity of 4 per cent, for an increase in the national utilization factor to 75.4%.

Load Factor Improved

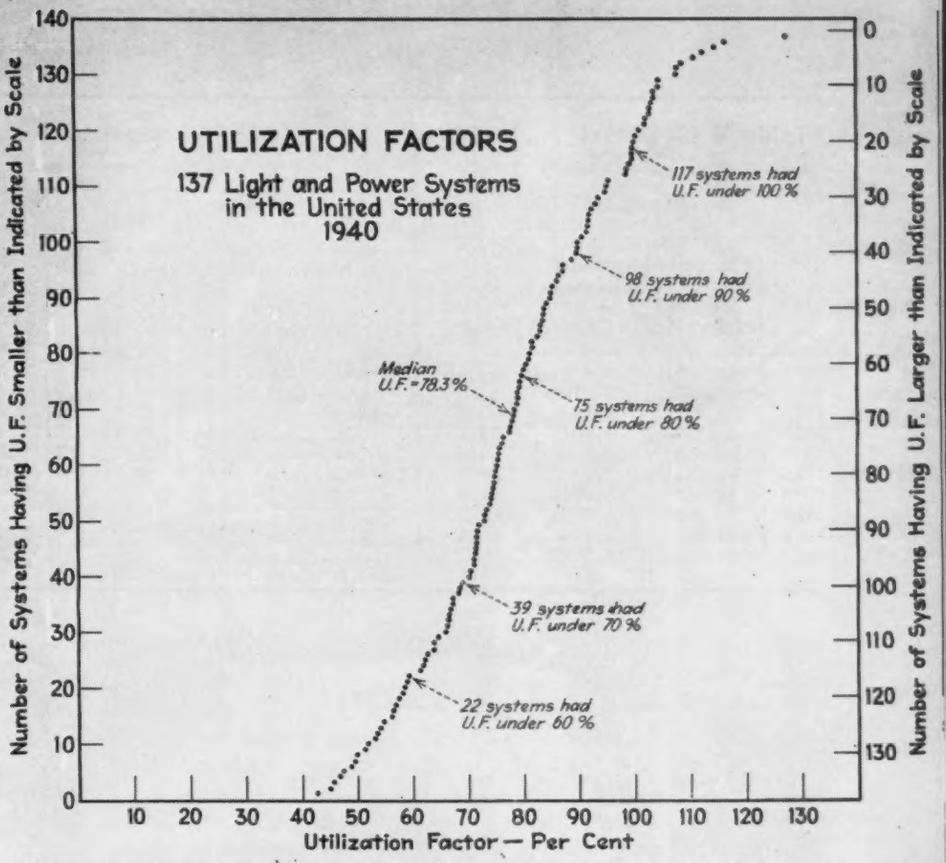
Load factor $\left(\frac{\text{kw.-hr. output}}{\text{peak kw. x } 8{,}760}\right)$ gives an indication of system performance. Last year increases over 1939 of 10.4 per cent in total output, including interchanged energy, with a rise in system peak of 8.1 per cent, effected an improvement in combined load factor (for 30 of the largest companies) to 55.7 per cent (Table V). In 1938 this factor was 54.5 per cent. The 1940 figure was exceeded in 1937 by a factor of 57.8 per cent.

The 30 companies included in the 1940 study of load factor had a combined output equal to 63 per cent of the total in the supplement. While corporate changes and other factors effect the annual totals shown in Table V for 1931 through 1940, the "combined load factors" are no doubt typical.

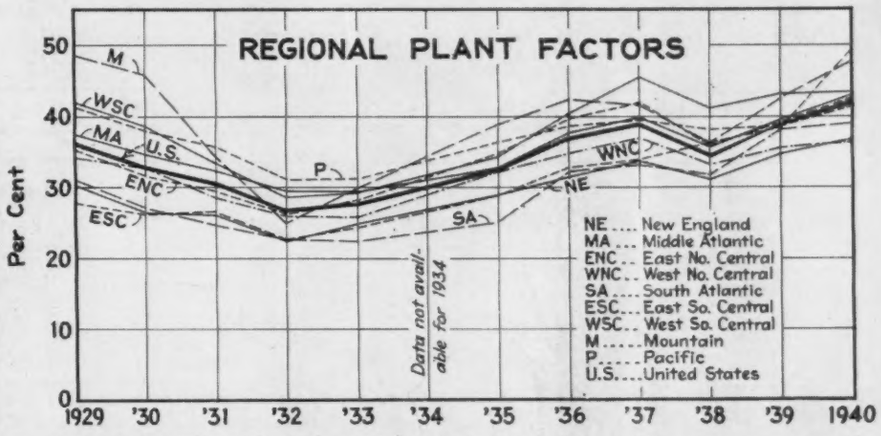
Another guide to station performance is plant factor $\left(\frac{\text{kw.-hr. generated}}{\text{plant kw. x } 8{,}760}\right)$ For the United States the average plant factor increased from 38.7 per cent in 1939 to 41.9 per cent in 1940, a record for the period covered (Table VI). Regional factors varied from 49.5 per cent in the East South Central states to 36.2 per cent in the West South Central to 34.6 per cent for the New England states. The original increase for 1940 over 1939 was most marked in the East South Central states, due in part, no doubt, to the increased availability of hydro energy. Incidentally, large federal and private additions are contemplated for the immediate future in this region.

For Canada a decrease in plant factor from 60.3 per cent in 1939 to 56.9 per cent in 1940 was brought about. War-time conditions prevented two Canadian systems from being included in the 1940 survey.

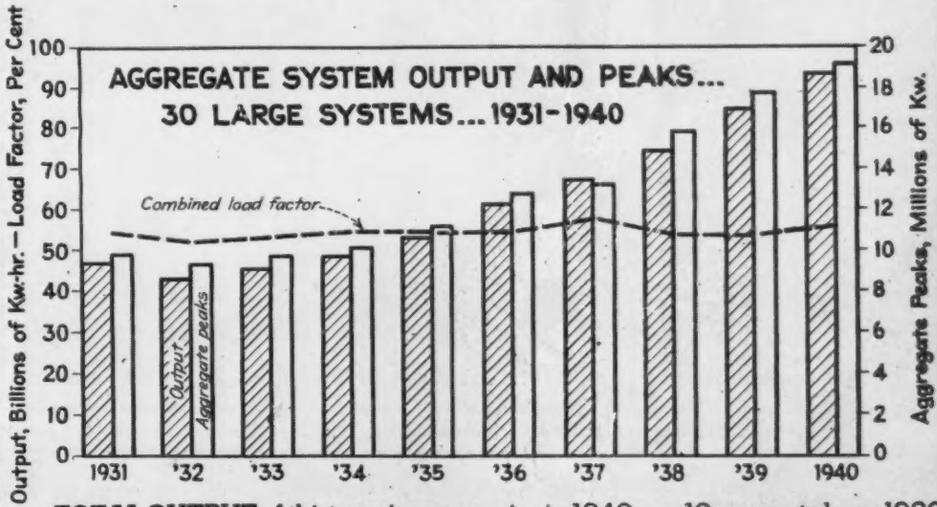
Allocation of output for 1940 (Table VII) shows nothing of a startling nature. While total output increased about 13 per cent over 1939, sales to ultimate consumers still ac-


UTILIZATION FACTORS
137 Light and Power Systems in the United States 1940
117 systems had U.F. under 100%
98 systems had U.F. under 90%
Median U.F. = 78.3%
75 systems had U.F. under 80%
39 systems had U.F. under 70%
22 systems had U.F. under 60%
Number of Systems Having U.F. Smaller than Indicated by Scale
Number of Systems Having U.F. Larger than Indicated by Scale
Utilization Factor — Per Cent

UTILIZATION FACTORS were lower than 80 per cent for 75 of these companies, whose combined capacity was 55 per cent of the total for the 137 utilities



REGIONAL PLANT FACTORS shared in the national increase to a record mark; the United States average moved upward from 38.7 in 1939 to 41.9 in 1940


AGGREGATE SYSTEM OUTPUT AND PEAKS...
30 LARGE SYSTEMS... 1931-1940
Combined load factor
Output
Aggregate peaks
Output, Billions of Kw-hr. — Load Factor, Per Cent
Aggregate Peaks, Millions of Kw.

TOTAL OUTPUT of thirty major companies in 1940 was 10 per cent above 1939 aggregate system peaks were 8 per cent higher; load factor was up 2 per cent

Table V — Output, Aggregate Peaks and Group Load Factors,

30 Systems, 1931–1940

Year	System Output Millions of Kw.-Hr.	Aggregate Peaks, Thousands of Kw.	Combined Load Factor, Per Cent
1931	46,989	9,870	54.3
1932	43,036	9,378	52.3
1933	45,435	9,714	53.3
1934	48,785	10,181	54.7
1935	53,019	11,120	54.3
1936	61,371	12,788	54.8
1937	67,089	13,256	57.8
1938	74,596	15,842	53.7
1939	84,875	17,775	54.5
1940	93,718	19,222	55.7

Table VI—Changes in Regional Plant Factors 1929–1940*

Generated Kw.-Hr. ÷ (Plant Kw. × 8,760) Expressed in Per Cent

Region	1940	1939	1938	1937	1936	1935	1933	1932	1931	1930	1929
New England	36.5	34.6	31.0	33.6	31.2	28.7	24.7	22.4	26.0	26.3	30.1
Middle Atlantic	42.9	39.4	35.5	39.9	37.2	32.6	29.3	29.4	32.3	34.7	37.3
E. North Central	42.3	39.2	35.9	41.8	39.7	34.7	28.0	26.1	29.6	31.5	35.1
W. North Central	36.2	35.4	33.0	36.7	34.5	30.2	25.7	25.9	28.6	32.7	34.1
South Atlantic (*a*)	38.9	37.9	31.6	32.9	32.0	24.9	22.2	22.4	24.6	27.0	30.9
E. South Central	49.5	38.4	36.0	33.8	32.5	28.8	24.2	22.5	26.3	26.1	27.6
W. South Central	43.2	43.1	41.0	45.2	40.3	34.1	29.1	28.6	33.2	38.6	41.9
Mountain	47.6	42.3	35.9	41.4	42.2	38.8	29.9	24.9	34.1	45.5	48.6
Pacific	41.4	38.4	38.2	39.3	38.5	36.0	31.1	31.0	35.5	37.8	41.1
United States (*a*)	**41.9**	**38.7**	**34.5**	**39.1**	**37.0**	**32.5**	**27.6**	**26.6**	**30.3**	**32.7**	**35.9**
Canada (*a*)	**56.9**	**60.3**	**55.8**	**59.0**	**57.2**	**53.2**	**43.4**	**42.7**	**44.4**	**51.1**	**61.7**

* Column for 1934 is omitted because data from which plant factors could be computed were not collected for that year.

(*a*) Omitting Duke Power, Abitibi Power & Paper, and Hydro-Electric Power Commission of Ontario, for which detailed data are not available.

counted for about 71 per cent of the total. "Industrial" or commercial wholesale consumers took a larger portion of the sales in 1940—53.3 per cent—than in 1939, but the percentage was still less than in 1937, when it rose to 55.5 per cent. Domestic consumers were next, having traded places since 1939 with the commercial retail classification.

Historians with a mind for precedent are likely to compare 1940 with 1915 because of the similarities in the two war periods. In ELECTRICAL WORLD for March 11, 1916, data were given for 37 companies, 36 of which were in the United States and accounted for 13,000,000,000 kw.-hr. out of a total for the country of 18,400,000,000 kw.-hr. In that issue it was reported that "data for 1915 show slackening in load factor for most plants and slight falling off in some individual outputs, due no doubt, to the depression incident to the European war." Load factor for the entire country averaged 54.5 and peaks aggregated 2,713,600 kw. that year. By 1916 output of the 41 largest companies had risen to some 15,500,000,000 kw.-hr. and aggregate peaks were 3,533,016 kw. Load factor dropped to about 50 per cent. For 1917 ELECTRICAL WORLD reported an output of 17,500,000,000 kw.-hr. by 44 companies in the United States, with aggregate peaks of 4,053,496 kw. Load factor that year was around 49 per cent.

Table VII—Allocation of Output of Major Light and Power Systems, 1929 to 1940

Class of Service	155 Systems in 1940			150 Systems in 1939			145 Systems in 1938			146 Systems in 1937			144 Systems in 1932			137 Systems in 1929		
	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales	Millions of Kw.-Hr.	Per Cent of Total	Per Cent of Sales
Farm or rural	2,641	1.8	2.5	2,122	1.6	2.3	1,983	1.7	2.4	1,824	1.5	2.1	9,814	11.3	17.0	7,561	8.0	11.3
Domestic	18,472	12.4	17.5	17,088	13.0	18.2	15,681	13.4	18.8	14,405	11.8	16.4						
Com'l retail	17,763	12.0	16.8	17,778	13.5	18.8	14,618	12.5	17.5	13,864	11.3	15.8	9,089	10.4	15.7	9,184	9.7	13.7
Com'l wholesale	56,385	38.1	53.3	47,088	35.7	50.2	41,943	35.9	50.3	48,819	40.0	55.5	29,993	34.6	51.8	41,752	44.1	62.5
Municipal	2,376	1.6	2.2	2,122	1.6	2.3	2,023	1.7	2.4	2,095	1.7	2.4	2,512	2.9	4.3	2,230	2.4	3.3
Other sales	2,091	1.4	2.0	1,795	1.4	1.9	1,669	1.4	2.0	1,227	1.0	1.4	1,231	1.4	2.1	971	1.0	1.5
Railways and railroads	5,980	4.0	5.7	5,872	4.6	6.3	5,491	4.7	6.6	5,684	4.7	6.4	5,234	6.0	9.1	5,149	5.4	7.7
Used by ult. consumers	105,708	71.3	100.0	93,865	71.4	100.0	83,408	71.3	100.0	87,918	72.0	100.0	57,873	66.6	100.0	66,847	76.6	100.0
Other public utilities	22,593	15.2	.....	19,251	14.6	.....	15,840	13.5	.....	16,606	13.6	.....	15,690	18.0	.....	13,290	14.0	.....
Affil. railway depts.‡	411	0.3	.....	409	0.3	.....	555	0.5	.....	574	0.5	.....	.....	.....	.....	.....	.....	.....
Used by companies	1,608	1.1	.....	1,426	1.1	.....	1,387	1.2	.....	1,275	1.0	.....	953	1.1	.....	1,395	1.5	.....
Losses, etc.	17,866	12.1	.....	16,619	12.6	.....	15,843	13.5	.....	15,792	12.9	.....	12,397	14.3	.....	13,199	13.9	.....
Total gen. & purch.†	148,186	100.0	.....	131,570	100.0	.....	117,033	100.0	.....	122,165	100.0	.....	86,913	100.0	.....	94,731	100.0	.....
Company use plus losses in per cent of generated†	.....	15.2	.....	.....	15.8	.....	.....	16.6	.....	.....	15.7	.....	.....	18.7	.....	.....	17.9	.....

† Excluding company that did not report allocation. ‡ Included in railways and railroads prior to 1937.

Multimeter Test Unit Increases Meter Checking Efficiency

Shop testing of watt-hour meters simplified by introduction of novel form of testing unit — New instrument uses modified gang test principle with automatic features — Used as alternate to stroboscopic testing

ROBERT J. BUSHNELL, Commonwealth Edison Company, Chicago*

WITH the general trend toward more accelerated methods for the shop testing of watt-hour meters there has come a recognized need for establishing testing facilities and procedures which are based on full consideration for the men who do the actual testing. With this in mind the Commonwealth Edison Company recently designed and placed in operation in its meter department a "Multimeter Test Unit" which has already established its practicability as a more productive, yet less fatiguing, means of testing watt-hour meters.

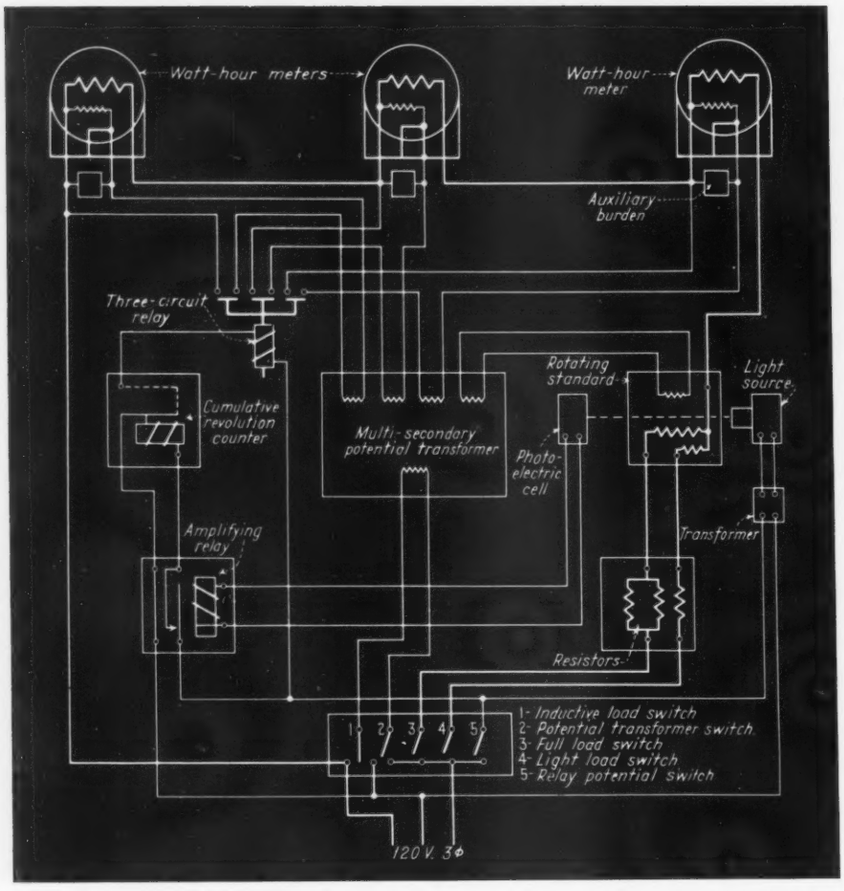
Through the application of a gang principle of testing and the use of certain automatic operating features in the design, this development has made possible an increase of 65 per cent in the production rate when compared with the conventional single-meter, manually performed testing procedure. Experience has demonstrated that with the multimeter unit a single operator can test 100 meters daily. Equally gratifying has been attainment of this production with an actual reduction in human fatigue.

Errors of meter registration are readily discernible with the equipment in increments of one-tenth of a per cent. More exact accuracy is possible, if desired. Automatic starting and stopping of the meters and electrically controlled revolution counting introduced in the design prevent the introduction of human errors, while relieving the operator of the need for constant observation of the meter disks.

The unit was primarily designed for making the initial test on new

ONE OF THE TWO positions of multimeter test unit developed by Commonwealth Edison Company. Each operator can make acceptance test on 100 meters per day with this equipment with less fatigue than with either stroboscopic or single-meter procedures

*Meter engineer.



DESIGN of multimeter unit for shop testing of watt-hour meters uses modified gang test principle incorporating automatic features for starting, stopping and revolution counting to reduce operator fatigue

5-amp., 120-volt, single-phase watt-hour meters before they are placed in service. It is, however, readily adaptable for testing meters returned from service or for meters of greater current ratings.

Alternate to Stroboscope

This development was not adopted with any intention of dispensing with the stroboscopic method of testing, but rather to provide an alternate test method. Two stroboscopic units are now being used successfully in conjunction with the two-position multimeter test unit. However, the stroboscopic method requires large batches of the same type of meters to achieve maximum efficiency. Also, the meters must have disks of a type supplied in recent types of meters only. Also, stroboscopic testing has a tendency to produce fatigue if continued by one tester for long periods. This is due to the need for more concentration and increased use of the eyes. By having an alternate method it has been found beneficial to let the testers rotate from one form of testing to another.

As already stated, approximately 100 new meters can be tested daily by a single operator on the multimeter. With an operator at both positions the production rate is doubled. In contrast, the stroboscopic method of testing permits a production rate of approximately 120 meters daily for each operator, but due to the aforementioned limitations of this method utilization of this rate of production is generally realized only during an exceptional demand for meters.

The multimeter unit consists of two identical three-meter test positions back to back, which can be operated independently. Basically, each test position operates on the gang principle, with the three meters and the rotating standard receiving voltage from a multi-secondary potential transformer, as shown in the accompanying diagram. The unit is supplied with three-phase, 120-volt service, and inductive load conditions are secured by cross-phasing. The current follows a series circuit through the meters, rotating standard and resistors.

Revolutions are determined by a photo-electric circuit which, when activated by the rotating standard disk, operates a revolution counter. This counter, in turn, actuates a relay which starts and stops the meters in accordance with the desired revolutions.

To test meters the operator places the black marker on each meter disk at a reference point before disk revolutions commence. The revolution counter is set at the desired revolutions. Current and voltage are applied by the use of toggle switches and the starting and stopping of the meters, as well as the counting of revolutions, are performed automatically. Accuracy of registration is determined by the position of the black marker on each disk after the revolutions are completed.

Action of the photo-electric circuit is controlled by a small collar on the disk of the rotating standard. Two holes in the collar permit the passage of the light beam once for each revolution of the disk. The revolution counter operates in such a manner that the rotating standard starts before the meters and is still operating after the meters have stopped.

The revolution counter relieves the operator of mental counting and constant observation of the meter disks. Observation of the rotating standard dial is not necessary for the testing procedure. However, an image of the illuminated dial face is visible through a window on the inclined panel. The image is projected with the aid of mirrors so the standard appears to be mounted on a 45 deg. angle. This optical system is provided merely to permit easy verification of the proper operation of the standard.

Convenience Features

Considerable attention was given to providing the most desirable conditions for the operators of the unit. The first consideration was to permit an operator to remain seated and to bring the meters and all testing operations within easy reach. Each meter panel is in a plane perpendicular to the operator's line of vision. Special meter cover holders are installed directly above each meter to eliminate lost motion and the necessity of placing the covers on the bench. The selector dial of the revolution coun-

[*Continued on page 133*]

Range, Water Heater Sales Pace Competition

New York Power & Light leads local selling field with 26 promotion men, financing arrangements, direct mail pieces, bonus payments to dealers and salesmen, wiring allowances and competitive rates

RALPH P. WAGNER,* New York Power & Light Corp., Albany, N. Y.

THE New York Power & Light Corporation is a division of Niagara Hudson Power Corporation operating in the eastern portion of New York State. The results of its 1940 electric sales operations among its 56,400 all-electric customers, who do not have the company's gas available, is shown in the following tabulation:

	Electric Ranges	Electric Water Heaters
1940 Gross sales	3,150	1,040
On lines December 31, 1940	22,420	6,810
Saturation	40%	12%
Estimated annual kw.-hr.	4,800,000	3,700,000
E.A.R.	$120,000	$65,000
Expense per $1 of E.A.R.	$.68	$.82
Rate available to customer per kw.-hr.	$.025	$.015*

*Residential rate provides for $0.015 per kw.-hr. after 200 kw.-hr. per month.

The backbone of the sales operation is a force of 26 dealer-customer promotion representatives with an average of fourteen years employment with the company. The company does no direct merchandising except in the case of conversion electric water heaters.

It is estimated, however, that the majority of all local appliance sales made are directly traceable to the salesmen's efforts. Sales of both electric ranges and water heaters are the direct result of the salesmen's efforts. This is even more true in the case of water heaters than ranges, as dealers are generally reluctant to sell water heating because they are not always sold on it themselves and the salesmen are reluctant to turn over prospects if there is the slightest chance that the dealer will fail properly to impress the customer. Salesmen are paid a salary plus a $2 bonus for each range and $3 for each water heater, factory or conversion.

*Commercial manager.

Don't Buy Any Range
...UNTIL YOU LEARN HOW MUCH YOU CAN SAVE ON THIS NEW PLAN DESIGNED TO BRING ELECTRIC COOKING TO HOMES NOW EQUIPPED WITH 2-WIRE ENTRANCES!
WIRING COSTS SLASHED
Electric Cookery now available to all!
MAIL COUPON TODAY!
or see your Electric Range Dealer!

BROADSIDE WARNING TO PROSPECTS—New York Power & Light used this "warning" to announce electric range wiring plan for rented homes as well owner-occupied homes

Ranges

The company is receiving stiff competition from bottled gas distributors, who have succeeded in selling approximately 7 percent of the all-electric customers, at rates which will average approximately 8 cents per pound of liquid petroleum. Since discontinuing direct sale of electric ranges the company has seen no reason to reverse its policy. It has found that ranges can be sold almost as easily through dealers as directly by the company and the expense is less. The policy has strengthened dealer relationship and has added materially to the number of dealers in the area speaking favorably of the company, its policies and the product which it is promoting. Dealers have quite generally accepted customer financing arrangements made possible through co-operation with Commercial Credit Company and known as the Economy Purchase Plan.

During the latter part of 1940 the company offered to pay the cost of changing the existing two-wire entrance to three wire. This payment

[*Continued on page* 134]

ALBANY PLAN IN OPERATION—Here one of the 26 promotion men of New York Power & Light sales force calls on a combination radio and electrical dealer in the territory. Sales literature, campaign plans, manufacturers' catalogs point up this contact call

Carbon Dioxide Safeguards Hydro Generators

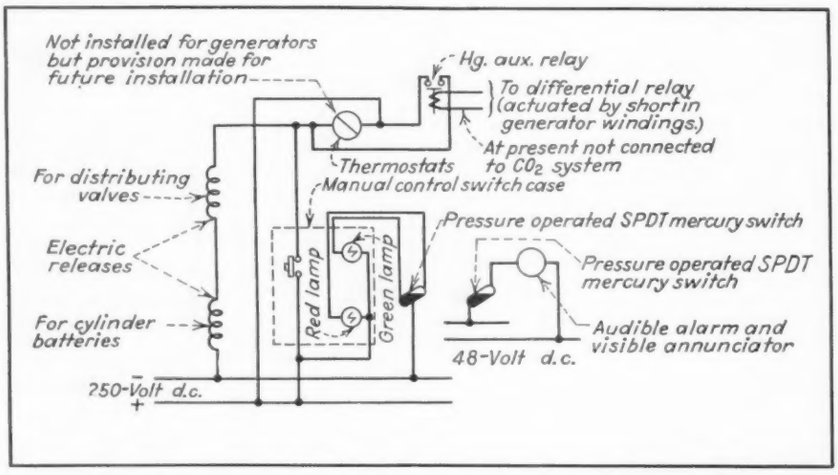
Bank of carbon dioxide cylinders supplying pipe lines fitted with directional valves floods rotating equipment and other hazards — Combination of smothering gas and water spray found to be effective in guarding transformer inclosures

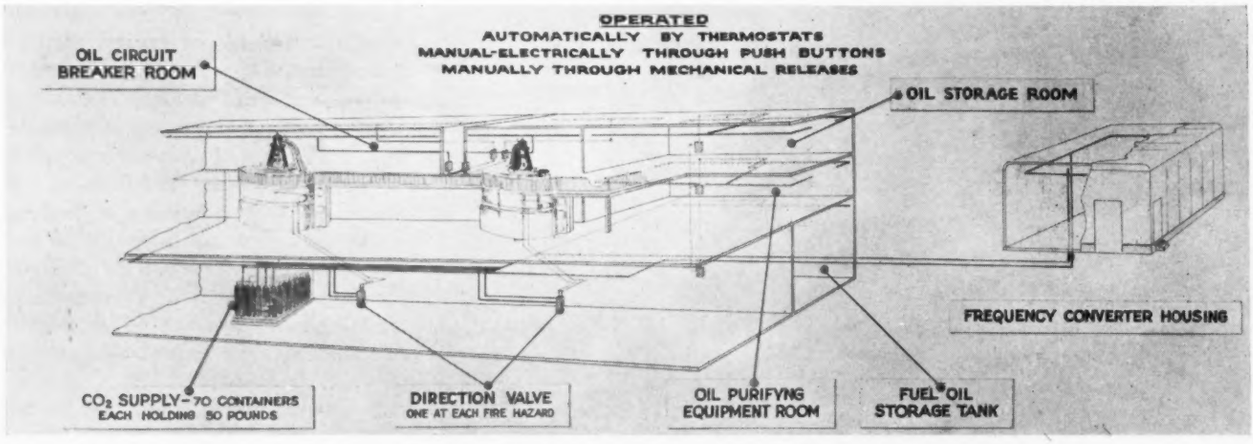
J. B. CUTLER, Mechanical Engineer, Pennsylvania Water & Power Company

CARBON DIOXIDE SYSTEMS form the main protection against fire damage and interruption of service at our two Susquehanna River hydro plants operating on the same system—one at Safe Harbor, Pa., and the other at Holtwood, Pa. These systems are designed to protect seven distinct fire hazards in the two stations, in addition to the main hazard in the Safe Harbor plant—the turbine-generators —which are of the inclosed type.

In the Safe Harbor station, which is the newest and largest plant, the extinguishing system consists of seventy 50-lb. carbon dioxide cylinders located near the center of the main building. This unusual installation has supply lines running throughout the plant and is equipped with automatic directional valves which permit the flooding of the following hazards with enough gas to extinguish a fire of any size:

1. Governor and transformer oil storage room; contains seven large oil tanks, each with a capacity of 12,500 gal., and three small tanks, with a capacity of 2,200 gal. each; total capacity, 94,100 gal.
2. Oil purification room.



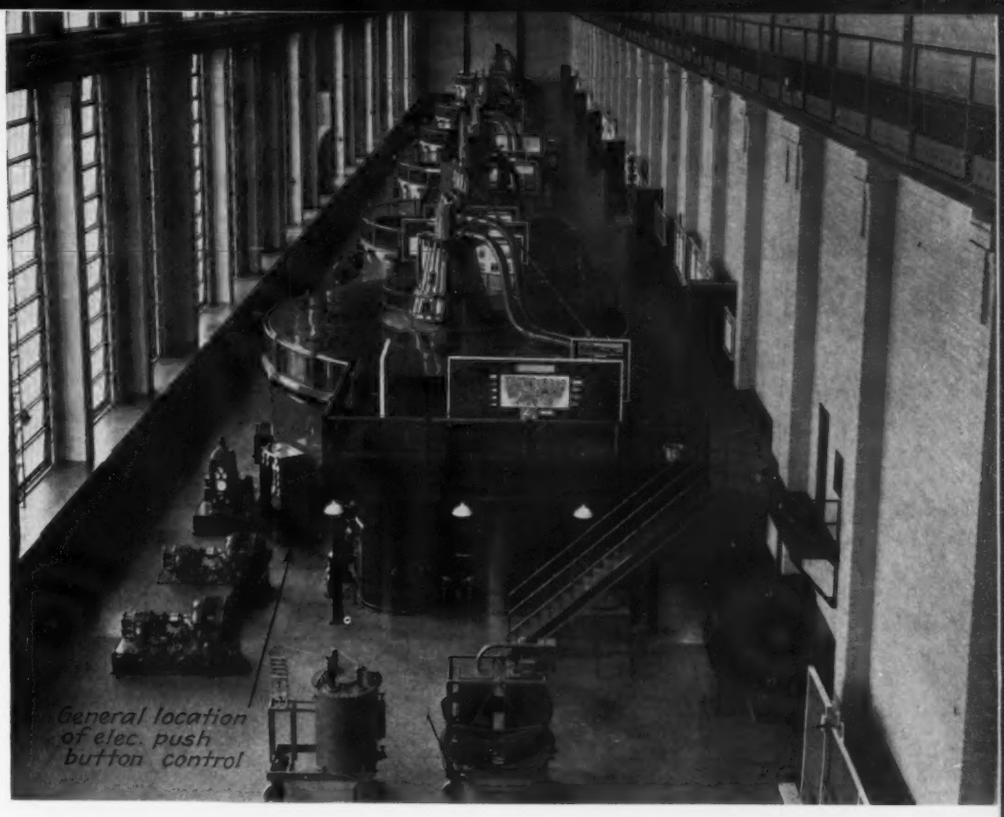

OPERATED
AUTOMATICALLY BY THERMOSTATS
MANUAL-ELECTRICALLY THROUGH PUSH BUTTONS
MANUALLY THROUGH MECHANICAL RELEASES
OIL CIRCUIT BREAKER ROOM
OIL STORAGE ROOM
FREQUENCY CONVERTER HOUSING
CO_2 SUPPLY—70 CONTAINERS EACH HOLDING 50 POUNDS
DIRECTION VALVE ONE AT EACH FIRE HAZARD
OIL PURIFYNG EQUIPMENT ROOM
FUEL OIL STORAGE TANK

SAFE HARBOR guards against fire damage and interruption of service with a carbon dioxide system utilizing a battery of carbon dioxide cylinders supplying pipe-lines running to the six hazards.

System is operated automatically by thermostats, manual-electrically through push buttons, or manually through mechanical releases. Typical wiring diagram shown above. Green lamp normally burns to indicate an inactive system. In case of fire at protected area, arrival of gas at hazard throws SPDT mercury switch to extinguish green lamp and light red lamp, also throws SPST mercury switch to sound an alarm and show on visible annunciator in control room location of hazard.

GENERATORS have manual control protection

Six of the seven vertical-shaft units shown; five in background rated 60 cycles, 36,000 kva., unit in foreground is single-phase, 25 cycles, 37,500 kva. for railroad supply. In addition to electric push button control, by which carbon dioxide gas may be discharged to inside of generator housing, a directional valve is also located at each unit on floor below. This may be operated manually by releasing the latch holding weights by which the valve is opened. When gas is released at either of these locations an alarm is indicated in control room, which is at a higher elevation behind the wall on the right-hand side.

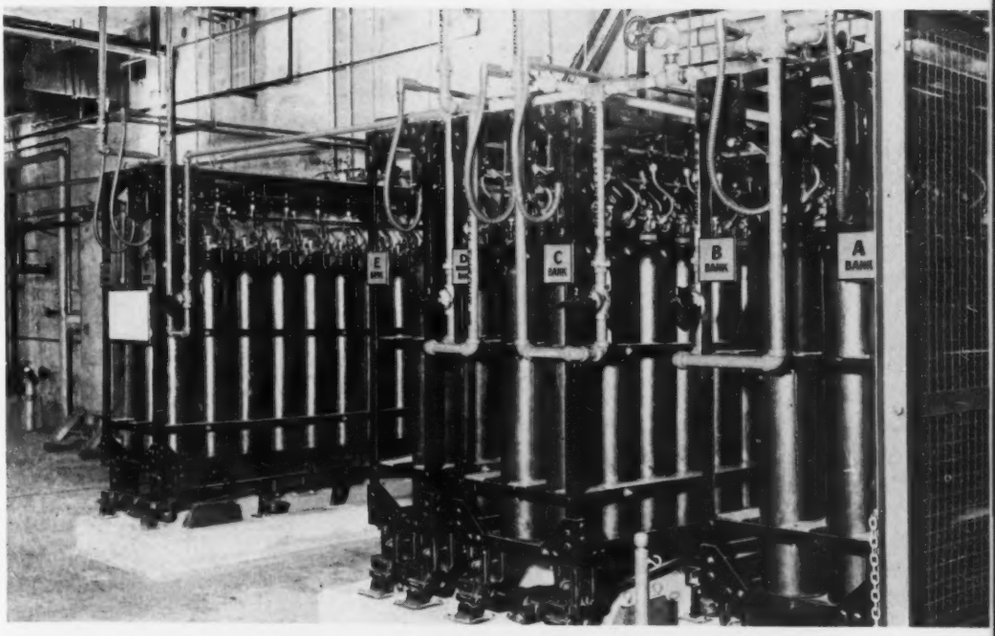


3. Fuel oil storage room; contains one 12,500-gal. fuel oil tank.
4. Oil circuit breaker rooms.
5. Frequency converter unit.
6. Main turbine generators.

Of these six hazards, the frequency converter unit — 32,250 kva. — requires the largest amount of gas. In event of fire in this unit the contents of fifty cylinders are released into the air circulating system in the initial discharge, while the delayed discharge—to compensate for any leakage—requires another ten cylinders. These discharges provide an imme-

SEVENTY 50-ton carbon dioxide cylinders protect six hazards at Safe Harbor

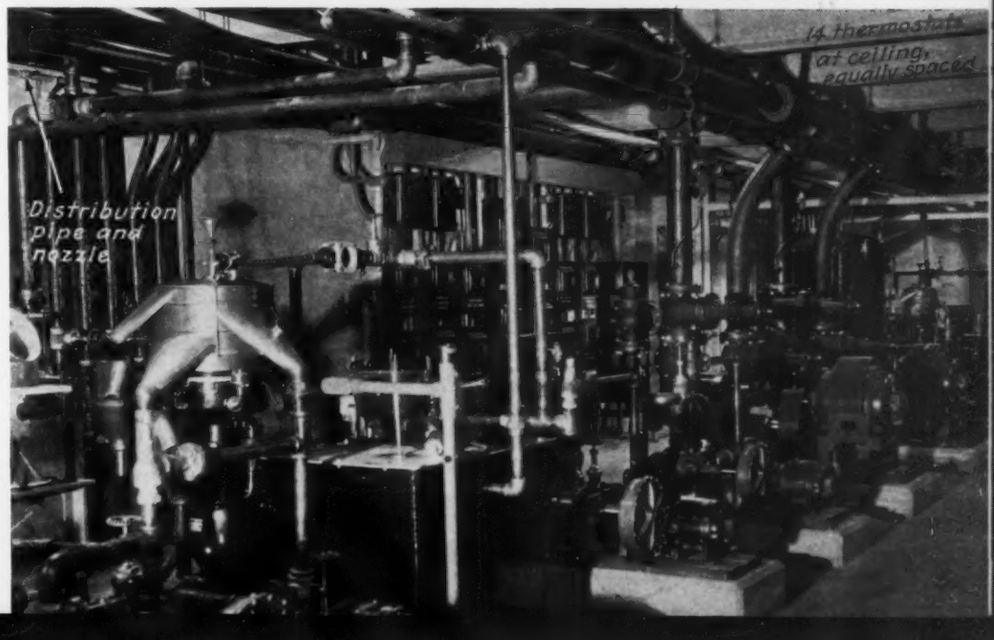
Fifty cylinders are discharged initially in the air circulating system of the frequency converter, ten being held for the delayed discharge. Remaining ten cylinders are reserve for additional discharge and spare capacity.

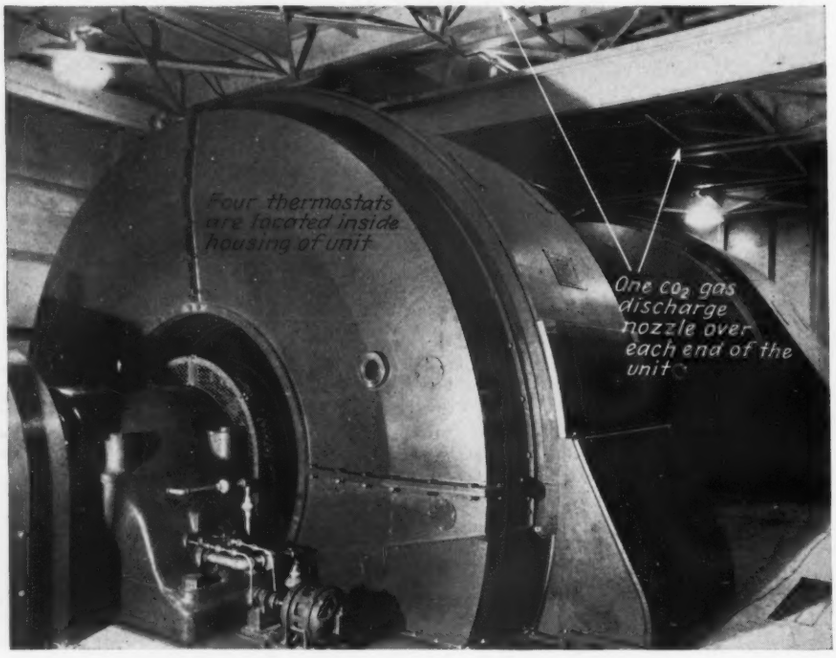


diate carbon dioxide gas concentration of approximately 45 percent in the converter and housing and maintain the proper concentration until the rotor comes to a standstill, thus stopping glow and confining damage to the point of original failure. This large amount of gas—

OIL PURIFICATION ROOM is completely flooded with carbon dioxide gas in event of fire

Gas may be admitted automatically through operation of fourteen thermostats spaced equally along ceiling, seven of which are close to north wall and seven close to south wall. Electric push button and manual release are also provided and located just outside main entrance door to room. When gas is discharged into this room an alarm is also indicated in the control room. Suitable pressure releases are installed in the gas line by means of which the ventilating fan is shut down and all doors and louvers automatically closed.





FREQUENCY CONVERTER is housed in this steel-walled inclosure

Fifty gas cylinders discharged initially and ten—for delayed discharge—flood the entire room in event of fire, stopping glow and preventing spread of damage. Electric push button control and manually operated directional valve are in substructure of installation. Provision has also been made for electric release of gas to this location from control room in main station. Alarm in control room again indicates discharge of gas at this unit.

3,000-lb.—is required because of the volume of the converter housing, really a steel-walled room with a net content of approximately 50,000 cu.ft. located just outside the main station.

Detection of fire in the converter unit is by thermostats and operation of the carbon dioxide valves is automatic, with an auxiliary manual-electric-push-button-release and a manual mechanical release.

Of the total of seventy cylinders, the remaining ten are held in reserve for additional discharge and spare capacity. This 500-lb. spare supply of carbon dioxide may be discharged into any of the seven hydro-electric units or into any of the oil storage or circuit breaker rooms in the event that fire occurred in one of them while the main bank was required for the converter. Normally, however, the varying number of cylinders can be used for a fire in any of these units or rooms, for each hazard has a directional valve which discharges the amount of gas necessary for the area in which the fire breaks out.

For releasing the gas, all of the hazards except the generators have both automatic thermostatic release and auxiliary manual control. For generator fires the gas may be discharged to flood the generator housing through manual or manual-electric operation only, though provision for installation of automatic thermostats, as well as tripping from the differential protective relays, has been made. Perforated water rings were furnished with each generator unit as secondary protection.

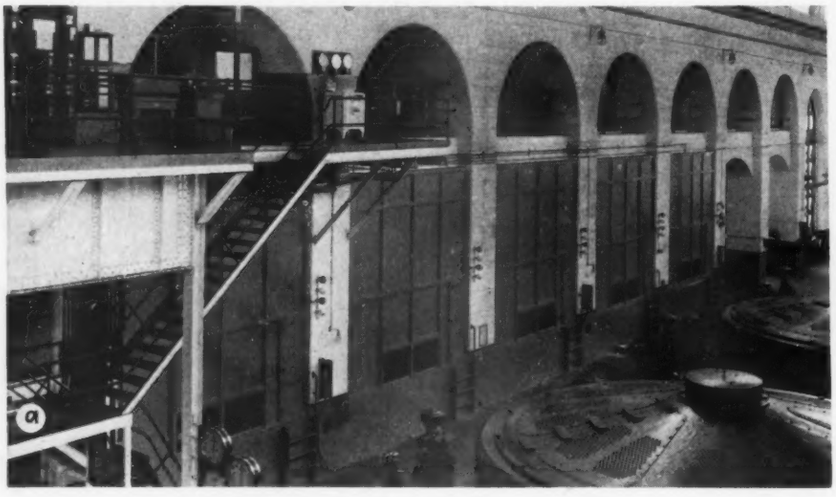
No Trace of Moisture

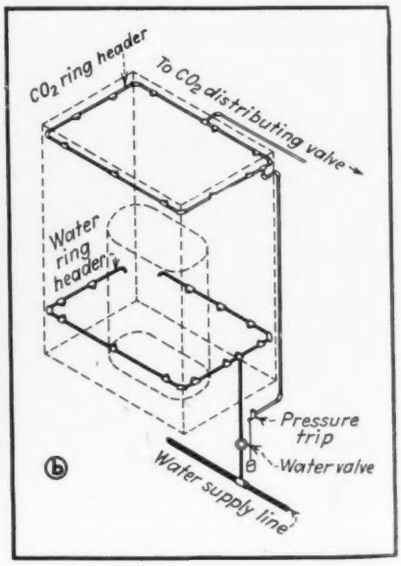
Selection of this type of fire protection was based on the fact that carbon dioxide is quickly effective on both the Class B and Class C hazards involved in the oil storage and processing, and in the rotating equipment when these hazards are located within inclosed areas. Another important consideration was the fact that the gas leaves no trace of moisture or residue and therefore requires no drying-out or clean-up period.

As part of the test on this gas system, we have set up gasoline torches and candles at various levels in an oil circuit breaker room and opened the system valves. The flames at all levels were extinguished in a few seconds, demonstrating the fast and certain extinguishing effect of the gas.

At the Holtwood, Pa., hydro-electric station we have a smaller built-in

[*Continued on page 131*]





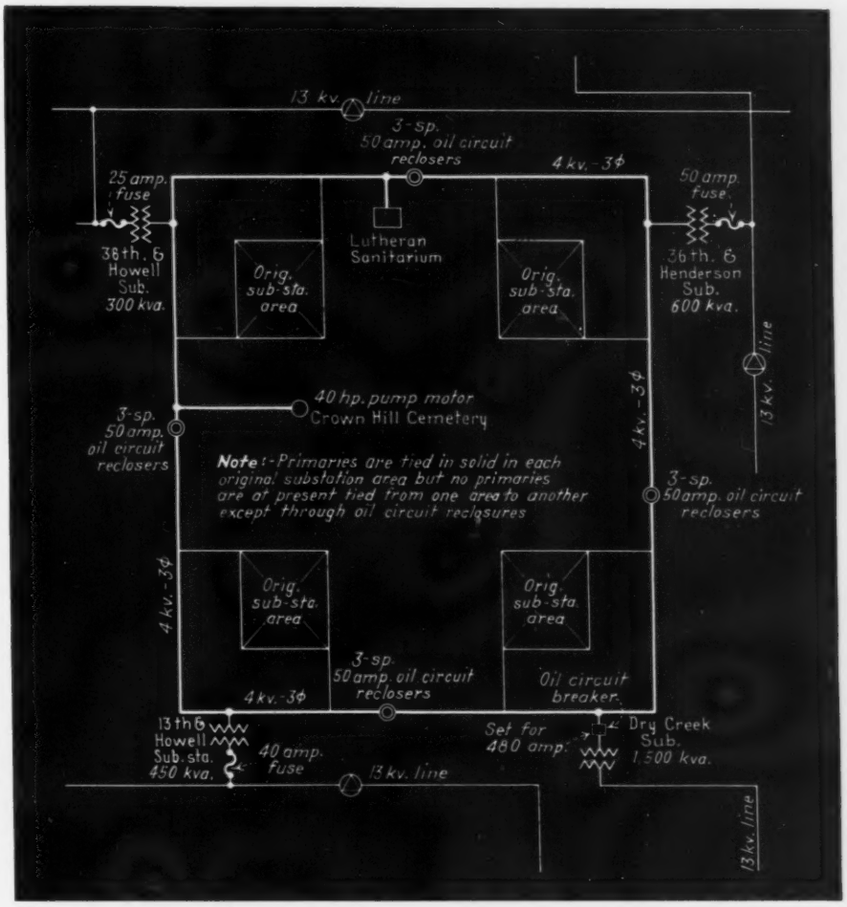
INDOOR TRANSFORMER INCLOSURES with steel panel front walls form one of three fire hazards at Holtwood. Carbon dioxide and water headers (b) of typical transformer pocket

Modified Primary Networks Solve Two Problems in Denver

Interconnect four substations through 4-kv. reclosers to correct substation overload and eliminate flicker and regulation difficulties — Eliminate individually regulated isolated phase areas and interconnect single-phase laterals in dense commercial-residential area

TWO MODIFICATIONS of the primary network idea, now in use by the Public Service Company of Colorado, have successfully solved distribution problems of a fundamentally different nature, arising from load development in an urban-rural and a growing commercial-residential area of Denver served by overhead lines. Experience with these two network adaptations is being used to guide the extension of the network idea to other sections of the city where distribution capacity needs reinforcement.

Earlier of the two applications, to be subsequently detailed, concerns regulation problems arising from a motor-induced flicker condition and an overloaded distribution substation in an outlying urban-rural area. In this instance the three-phase, 4-kv. feeders emanating from four 13/4-kv. distribution substations at the corners of a 4-mile square inclosing the troubled area were interconnected through 50-amp. automatic pole-top reclosers, and transformers tapping the 4-kv. The primaries within the original substation areas were haphazardly networked by tieing in solid wherever possible. Transformers, according to previous practice, are banked. Reinforcement of the system so secured has effectively reduced primary flicker to allowable limits and greatly improved regulation.

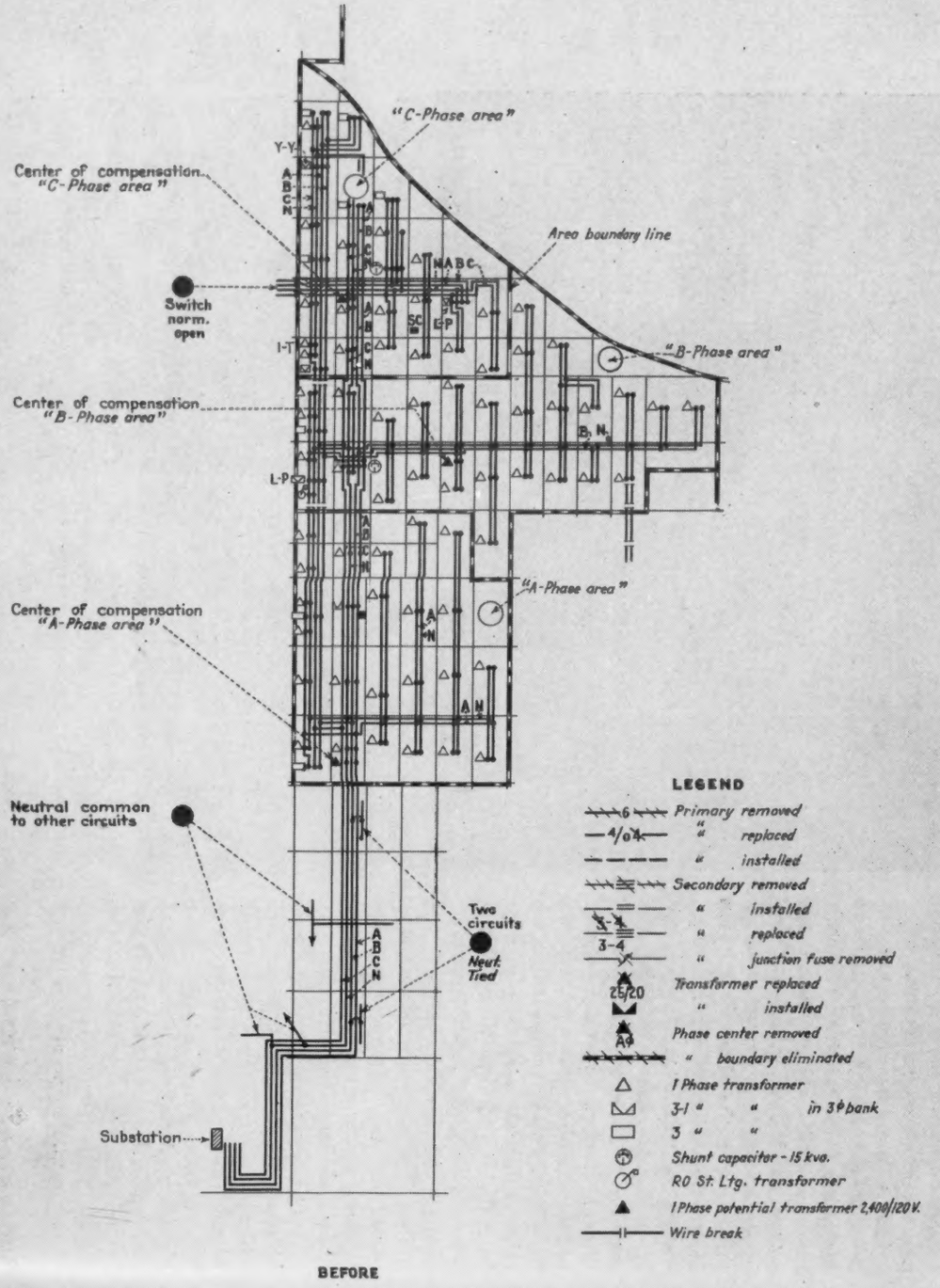

13 kv. line
3-sp. 50 amp. oil circuit reclosers
4 kv.-3φ
25 amp. fuse
50 amp. fuse
Lutheran Sanitarium
Orig. sub-sta. area
Orig. sub-sta. area
36th. & Howell Sub. 300 kva.
36th. & Henderson Sub. 600 kva.
13 kv. line
40 hp. pump motor Crown Hill Cemetery
3-sp. 50 amp. oil circuit reclosers
4 kv.-3φ
Note:-Primaries are tied in solid in each original substation area but no primaries are at present tied from one area to another except through oil circuit reclosures
3-sp. 50 amp. oil circuit reclosers
Orig. sub-sta. area
Orig. sub-sta. area
4 kv.-3φ
3-sp. 50 amp. oil circuit reclosers
Oil circuit breaker
4 kv.-3φ
13th & Howell Sub. sta. 450 kva.
40 amp. fuse
Set for 400 amp.
Dry Creek Sub. 1,500 kva.
13 kv. line
13 kv. line

INTERCONNECT 13/4-kv. substations through reclosers to reduce pump-motor induced flicker and relieve substation overload

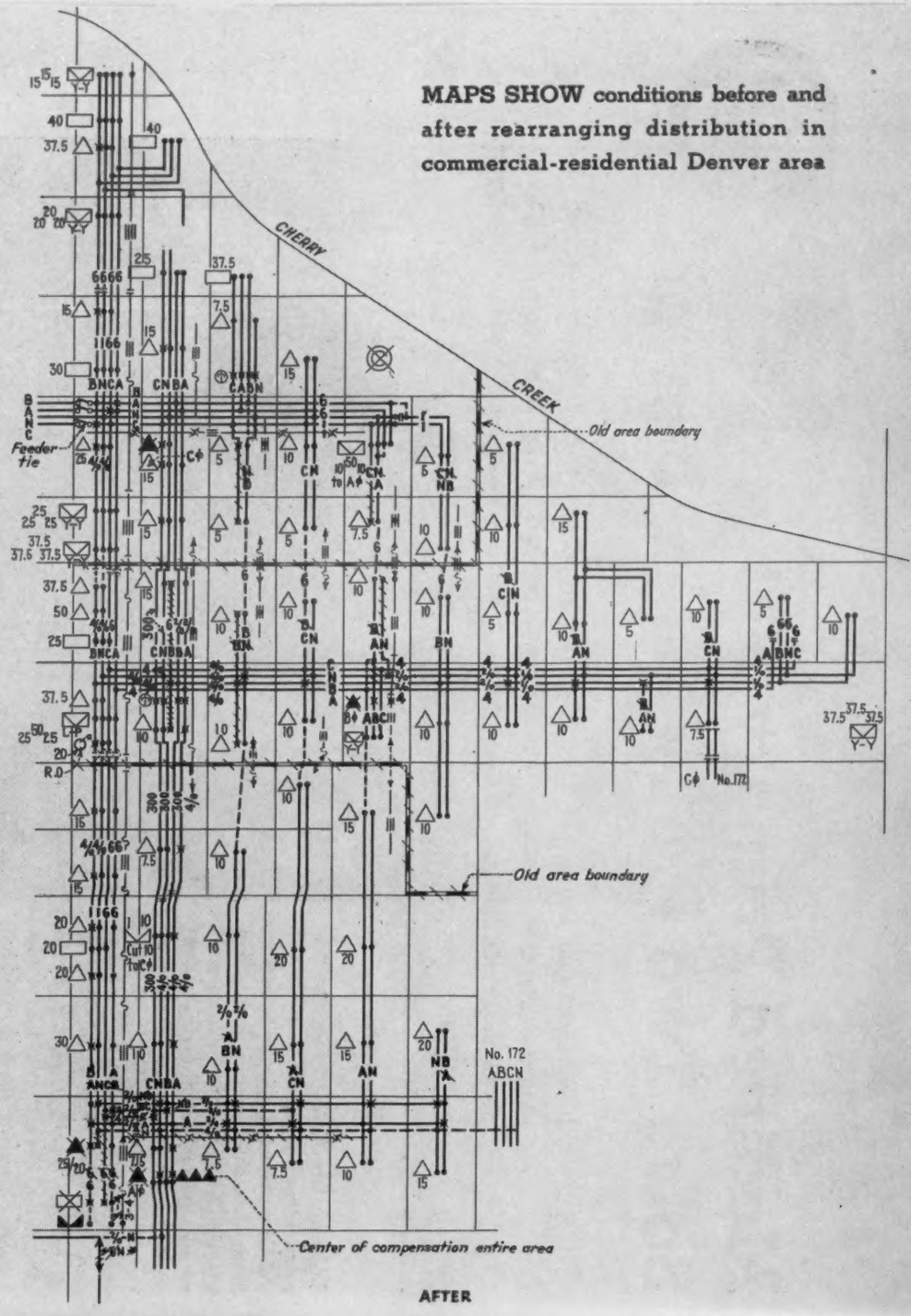
Second installation involved a combination commercial-residential area adjacent to a main Denver shopping center. This area had previously been divided into three isolated, individually regulated, single-phase areas, each served by single-phase branches tapping different phases of three-phase main feeders. Wide separation of the regulation points and growth of three-phase load in certain locations had produced unequal voltage and loading in three-phase banks, producing excessive fuse operation. Solution lay in elimination of phase areas, extension of three-phase branch main into previous single-phase areas and interconnection or "networking" single-phase branches of the same phase between the mains, to improve voltage at the end of laterals. Transformers on laterals, according to past practice, were extensively banked and a single regulation point selected for the entire area, as will be described subsequently in detail.

The urban-rural area mentioned was served at 4 kv. by three-phase, four-wire radial feeders from four 13/4-kv. substations located roughly

MAPS SHOW conditions before and after rearranging distribution in commercial-residential Denver area



BEFORE



AFTER

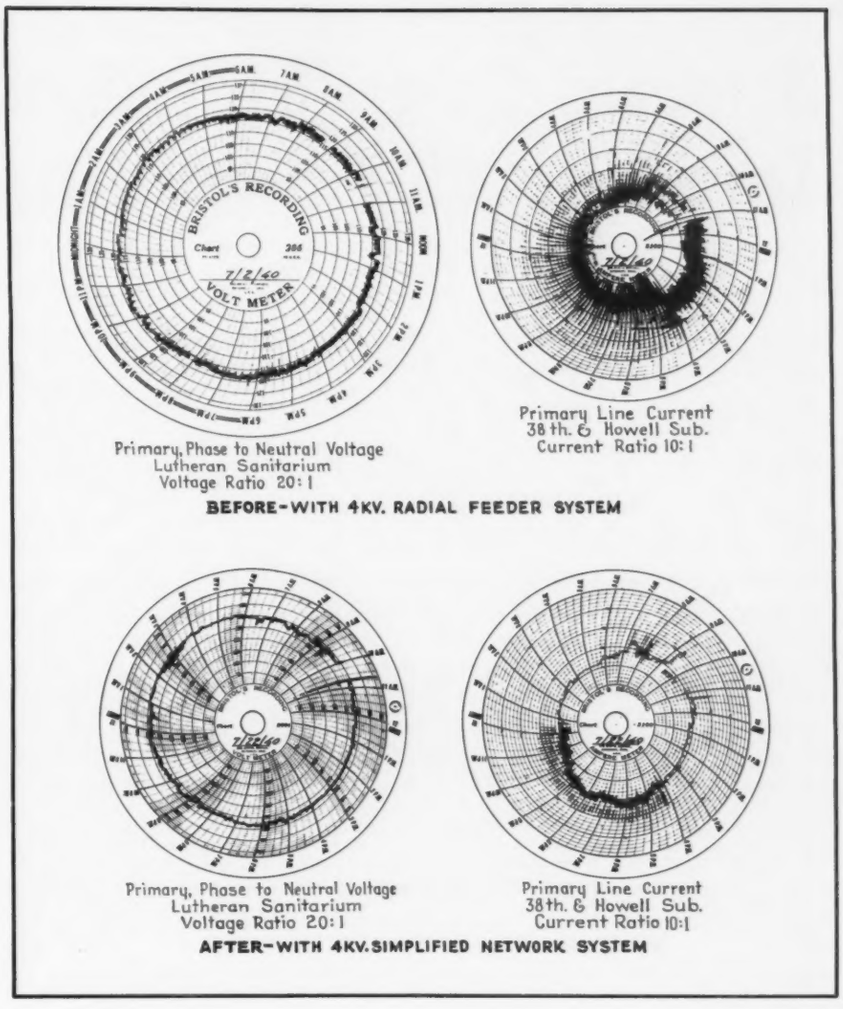
at the corners of the rectangular area. Flicker trouble was traced to fluctuations of primary line current caused by a 40-hp. induction-type pump motor at a nearby cemetery. These fluctuations not only produced a serious flicker condition but also interfered with operation of X-ray equipment at an adjacent sanitarium served from the same substation at 38th and Howell Streets (see diagram). Poor regulation in this same 4-mile square area was also being experienced due to overloaded condition of transformers at the Thirteenth and Howell substation.

Interconnect Substations

One solution to the problem lay in increasing capacity of the Thirteenth and Howell substation serving the area as isolated station, installing regulators and possibly reinforcing the copper capacity to serve the pump motor out of the 38th and Howell substation. Less costly expedient, however, was recourse to a 4-kv. primary network, tying the substations together, as show on the 4-kv. side through automatic reclosers. This course also offered an opportunity to experiment with primary network operation with the idea of using it, if successful, in other sections of Denver where distribution capacity needed reinforcement.

Accordingly systematically located, 50-amp. automatic "three-shot" oil circuit reclosers were installed in each phase of the 4-kv. primary circuits between the substations, as shown, without making any other changes. Within the loop so formed the company is gradually working toward a grid arrangement. Primary laterals within the loop are being limited to No. 4 copper and under. Interconnection of primaries within the loop as yet, however, is being approached cautiously, for safety reasons, since company linemen have been trained on a radial system and too rapid a change to two-way feed might lead to accidents. Distribution transformers within the loop are banked on the secondary side. Fusing at the midpoint secondaries is approximately equal to one-half the kva. rating of the smallest adjacent transformer.

Reduction in flicker and improvement in voltage regulation since installation of the overhead network is evident from the accompanying "after" charts.



VOLTAGE CHARTS show improvement in regulation after interconnecting substations

Since installation of the reclosers there have been 36 single-phase recloser operations (from July 18 to December 18, 1940), 23 of which were traceable to a single short circuit on the cemetery circuit. Other operations were self-clearing faults. Operation of the network was entirely satisfactory. Immediately following the short circuit mentioned the three reclosers between Thirteenth and Howell and 38th and Howell and the three between 38th and Howell and 36th and Henderson went through a complete cycle and locked out, isolating the fault from the rest of the network. When the fault failed to clear the three primary fuses at 38th and Howell blew, disconnecting the bank. Linemen responded, closed two of the reclosers, repaired the damage on the third-phase and later reclosed it.

While the network has been in operation hardly long enough to permit definite conclusions, its performance during seven months has demonstrated its ability to eliminate objectionable flicker and stiffen the system.

As shown in the accompanying "before" circuit diagram, the commercial-residential area adjoining one of Denver's main shopping centers was formerly served from three-phase main feeders running north from the substation. The service area was divided into three roughly equal isolated phase areas served by single-phase lines that tapped different phases of the three-phase main feeders of the four-wire, 4-kv. common grounded-neutral system. Feeder voltage regulators on each phase of the main feeder were located at the substation and compensated to load centers in each phase area indicated on the diagram.

This arrangement, while satisfactory when originally designed, has outgrown itself due to changes in the

[*Continued on page 132*]

Special Regulator Settings Improve Circuit Voltage

Use of two regulators to govern voltage at different load centers where balanced three-phase voltages are not imperative — A method of regulating where capacitors are in use

HOWARD S. LEWIS,* Central Vermont Public Service Corporation, Rutland, Vt.

ALTHOUGH considerable information can be found regarding setting contact-making voltmeters and line drop compensation on induction voltage regulators, there is little concerning these settings when special regulator connections or special circuit arrangements are used or when capacitors are used on a circuit.

When the absence of three-phase load on a circuit makes it possible to supply unbalanced phase voltages, the load on the circuit may be connected so that the third of the load nearest the substation is on one phase, the third farthest from the substation on another phase and the remaining load at an intermediate distance connected to the third phase. Then, on a delta circuit, two regulators may be cross-connected so that the first third of the circuit is connected to the phase of lowest voltage and the last third to the phase of highest voltage.

Unbalanced voltages can also be produced without the regulator cross-connection by using unequal contact-making voltmeter and line drop compensation settings on the regulators.

Capacitors are generally installed for improvement in voltage level and reduction of circuit loading, but special regulator settings may be used for improvement in voltage regulation.

Cross Connection

The cross-connection scheme of using two 10 per cent regulators to give 7, 10 and 15 per cent regulation is effective provided the bus regulation is nearly constant. Thus, if the bus is maintained at 117 volts at no load plus 5 volts compensation at full load, then phases 1–2 and 2–3 will each be 122 volts at full load and phase 1–3 approximately 128.8 volts. If the bus voltage should drop to 113, the regulators would increase their voltage boost from 5 volts to 9 volts to hold phases 1–2 and 2–3 at 122 volts at full load. Phase 1–3 would then be approximately 134 volts. If the bus should rise to 121 volts during light load on the regulated circuit the regulators would buck the potential down 4 volts to hold phases 1–2 and 2–3 at 117 volts, and phase 1–3 would then be approximately 111 volts.

It is also evident from the foregoing that the regulators on phases 1–2 and 2–3 will hold the same voltage up to the point where the regulator on phase 2–3 has reached its full boost (7 per cent) position. In order to have both regulators reach full boost at the same load, it is necessary to decrease the compensation on the phase 2–3 regulator and increase

* Distribution engineer.

Value of Several Arrangements for Voltage Regulation

Arrangement	VM. Setting			Compensation in Volts						Primary Voltage											
	Phase			Phase 1–2		Phase 1–3		Phase 2–3		A		B		C		D		E		F	
	1–2	1–3	2–3	LL	FL	LL	FL	LL	FL	LL	FL	LL	FL	LL	FL	LL	FL	LL	FL	LL	FL
		Circuit only — Bus 122 V.								122	122	121.5	117	121.5	117	121	113	121	113	120.5	110
1	117	....	117	0.5	5.0	....	....	0.5	5.0	117.5	122	117	117	117	117	116.5	113	116.5	113	116	110
2	117	117	....	0.5	5.0	0.5	5.0	....	....	117.5	122	117	117	117	117	116.5	113	117.5	119.8	117	116.8
3	117	....	117	0.5	5.0	....	....	1.4	14.0	117.5	122	117	117	117.5	121.5	117	117.5	117.4	122	116.9	119
4	117	117	....	0.5	5.0	0.9	9.0	....	....	117.5	122	117	117	117.4	121	116.9	117	117.5	122	117	119
5	117	....	117	0.5	5.0	....	....	0.5	5.0	117.5	122	119	119	119	119	120.5	117	120.5	117	122	116
6	117	117	....	0.3	3.0	0.8	8.0	....	....	117.3	120	118.8	117	119.3	122	120.8	120	120.8	122	120.3	119
7	117	....	117	0.5	5.0	....	....	1.0	10.0	117.5	122	119	119	119.3	121.5	120.8	119.5	121	122	120.5	119

ARRANGEMENT

No. 1 Regulators in phases 1 and 3 — standard connection — Bus 117 volts.
2 Regulators in phases 1 and 2 — cross-connection — Bus 117 volts.
3 Same as No. 1 but with unequal compensation.
4 Same as No. 2 but with unequal compensation.
5 Same as No. 1 but with capacitors—2V. rise A-B, 2V. C-D, 2V. E-F.
6 Same as No. 4 but with capacitors—2V. rise A-B, 2V. C-D.
7 Same as No. 3 with same capacitors as No. 6.

Note: " LL " — Light Load. " FL " — Full Load.

the compensation on the phase 1–2 regulator. The load on phase 2–3 needs less compensation than that on phase 1–2, since it is connected on the nearest third of the circuit.

In the case above, the compensation on the phase 2–3 regulator might be 3 volts at full load and the regulator on phase 1–2 might be set for 7 volts compensation. Then, with a bus voltage of 117, phase 2–3 would be held at 120 volts, phase 1–2 at 124 volts and phase 1–3 at 126.5 volts at full load.

Substation Bus

In substations where the bus varies more than 1 or 2 volts or where the bus is held at a higher value than the contact-making voltmeter setting of the regulators, in order to utilize the full buck and boost capacity of the regulators, this arrangement cannot be used as the bucking position of the regulators at light load would cause abnormally low voltages on phase 1–3. In the majority of cases where unbalanced phase voltages are desirable it is probably necessary to use the standard regulator connection. This method can be used when the bus voltage is not constant or when it is held at a higher value than the contact-making voltmeter setting.

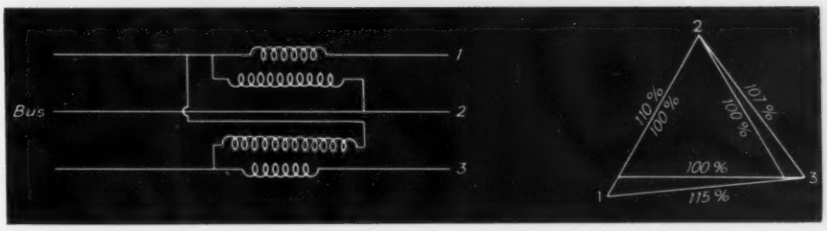
With 5 volts compensation on the phase 1–2 regulator and 10 volts on the phase 2–3 regulator phase potentials at full load would be 122 volts on phase 1–2, 124.5 volts on phase 1–3 and 127 volts on phase 2–3. The load on the farthest third of the circuit would be connected on phase 2–3, instead of phase 1–3 as in the cross-connection scheme.

When capacitors are used on the circuit, either of the above schemes is applicable. In some cases it is possible to use a lower contact-making voltmeter setting and a higher line drop compensation setting because of the higher voltage level on the circuit.

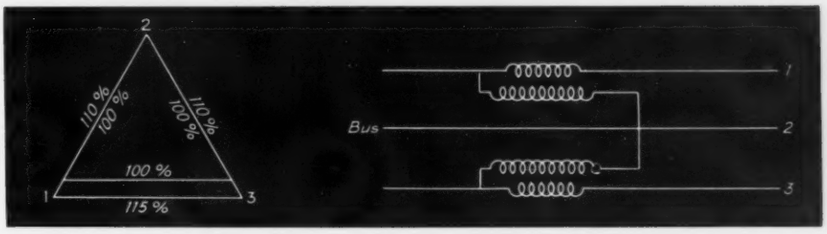
In order to show the effects of the various arrangements and the contact-making voltmeter and compensation settings required, the primary voltages at various points on a sample distribution circuit of very poor regulation are shown in the table. The settings used are such that the primary potential at any point does not exceed 122 volts.

By plotting the voltage variation at each point against the distance from the substation, assuming the custom-

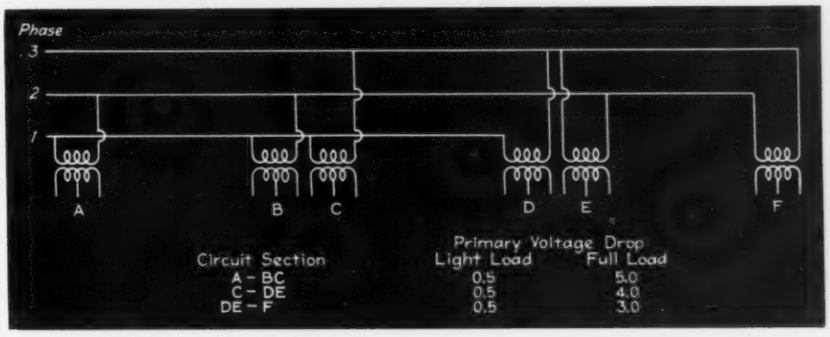
[*Continued on page 138*]



CROSS-CONNECTION of two regulators on delta circuit to handle different load centers



USE of standard regulator connection where unbalanced phase voltages are desirable



SAMPLE distribution circuit with poor regulation

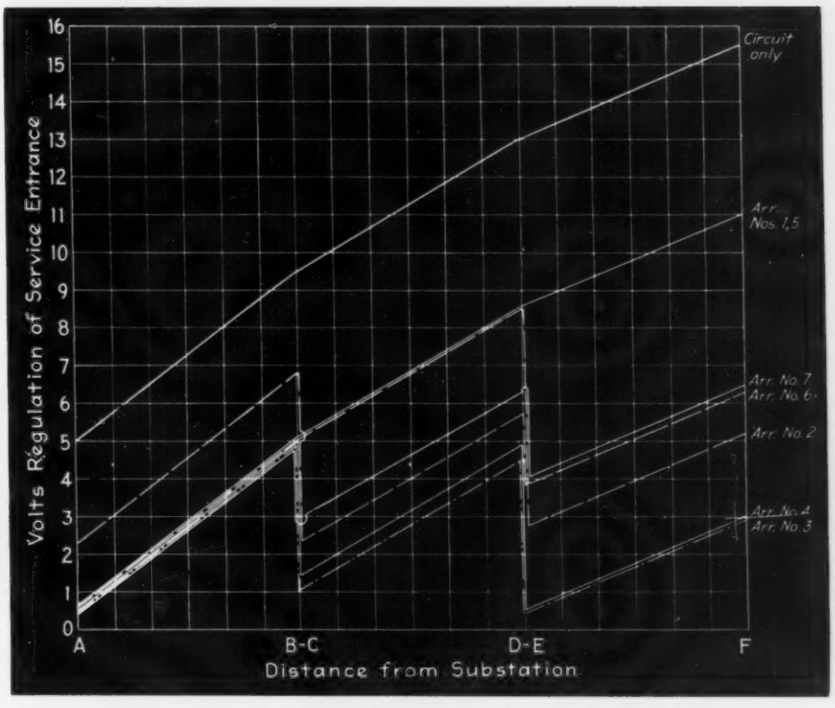
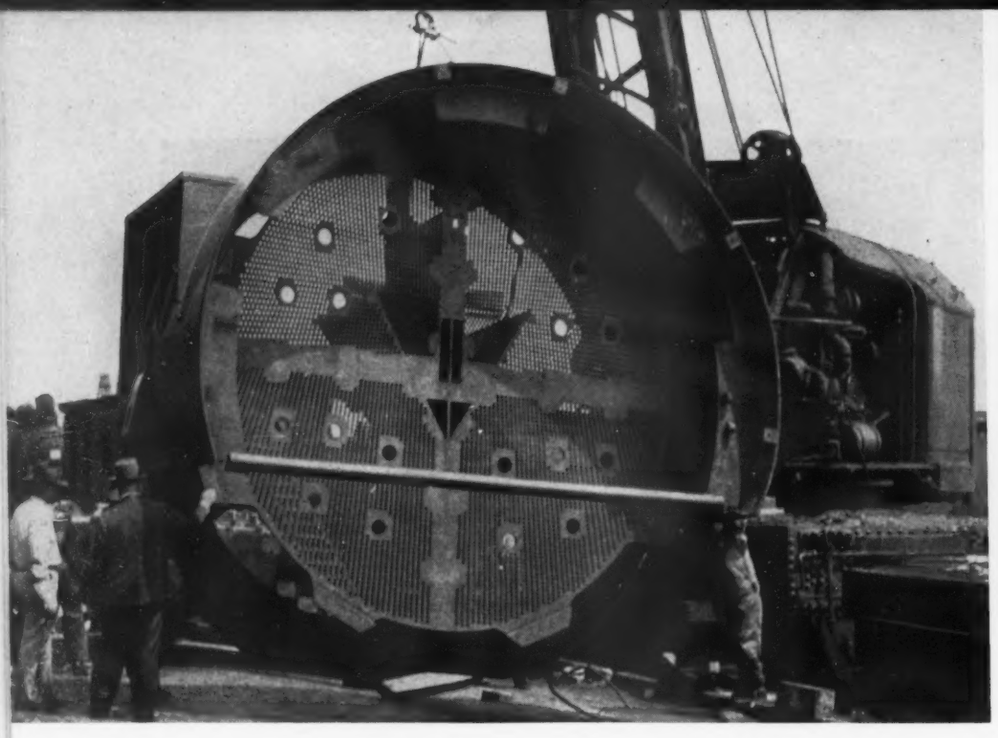


CHART showing voltage regulation with different schemes discussed



RAILROAD wrecking crew removed condenser section from flat car. Sections were shipped in part on deep-floor cars to meet bridge and tunnel clearance requirements. At one place there was less than 1-in. clearance

Favorable availability of equipment combines with well-organized construction program to increase capacity in one-third customary time

Adds 25,000 Kva. in Five Months

H. W. BUTTON, Vice-President Laclede Power & Light Company, St. Louis

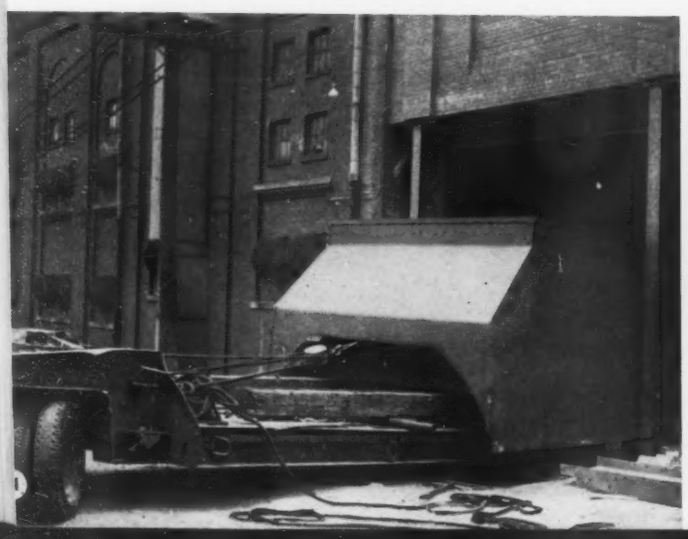
EARLY in 1940 it became evident that increase in generator capacity on the Laclede system was desirable. Due to the fact that the delivery date on a new machine was from twelve to fifteen months, attention was turned to used machines. While there were several available, it became evident that in each instance there was some serious drawback to purchase and installation. Inquiries to one manufacturer developed the fact that there had been a recent cancellation of a machine, which in voltage, steam pressure, temperature and size coincided almost exactly with station requirements. Urgent inquiries were sent to various condenser manufacturers and almost unbelievable deliveries were promised.

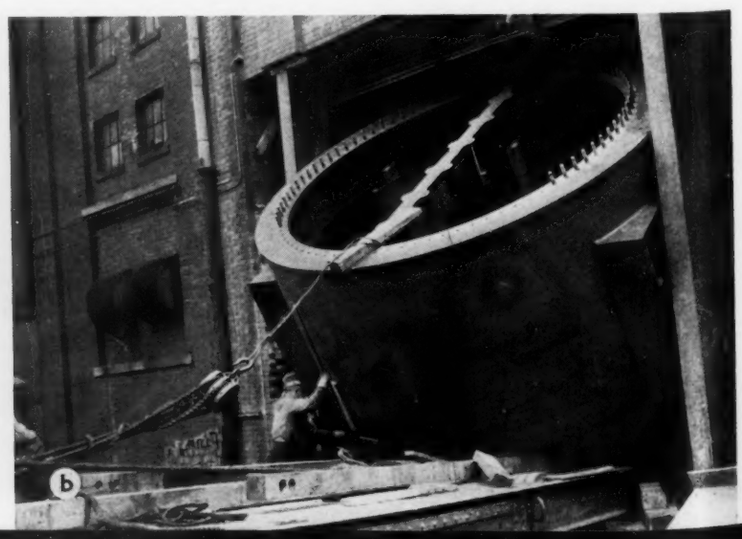
On March 5 the order for the turbo-generator was signed, followed on March 6 by the order for the condenser and auxiliary equipment. On March 9 the work of demolition of an old building on the available space was started. The location was such that the new construction became in fact a continuation of the present turbine room.

Space limitation made it necessary to arrange the equipment considerably different from the conventional design. The space available was 26 ft. wide and approximately 76 ft. long, with the upper level determined by height of the existing crane rail, in the present turbine room, which was later extended. The foundation level was determined only by the amount of rock of limestone nature that it was economical to excavate.

Due to the necessity of haste, work was started almost immediately, keeping in mind necessary clearances for

CONDENSER PARTS manipulated through narrow openings into building. (a) Top section being taken between building columns. (b) Another section also passed between closely spaced columns. All the heavy parts were moved on a trailer from 200 to 400 ft.





equipment, the dimensions of which were at that time not entirely determined.

A condenser was selected from a drawing already completed, to avoid the necessity of designing a piece of special apparatus, and this was built accordingly, with only very slight modifications.

The foundation was started before the excavation was completed and was designed to permit the installation of the condenser parallel to the turbine shaft, with provision to install and remove condenser tubes in a space over the hotwell pump pits. Oil coolers and extraction heater and piping were installed in this space, but designed so that they do not interfere with the condenser tube installation. In order to leave space for the generator air coolers, the section of condenser connecting to the turbine was offset 2 ft.

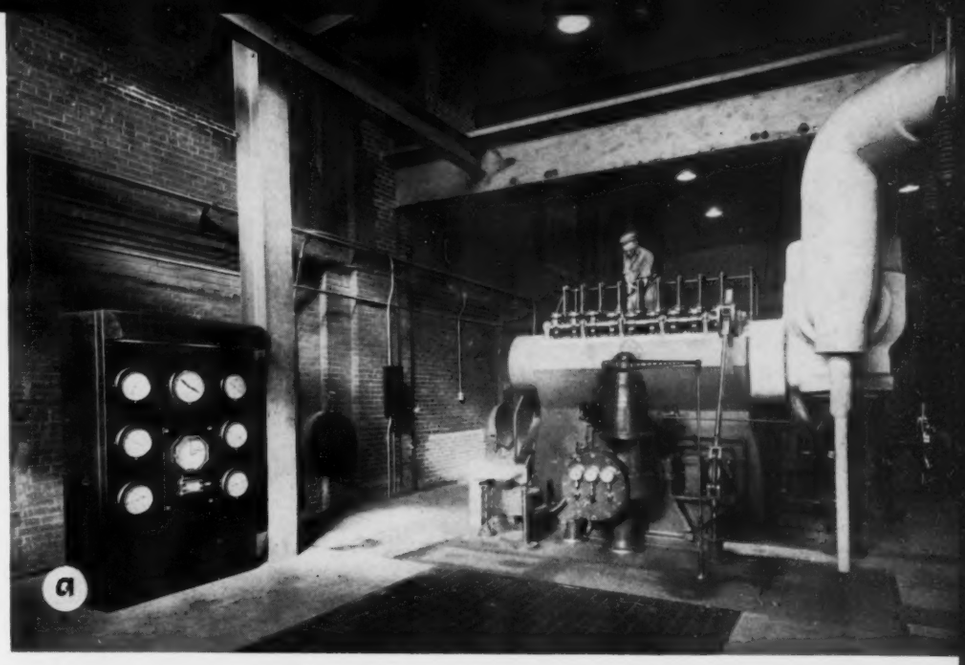
Deep Cross Beams

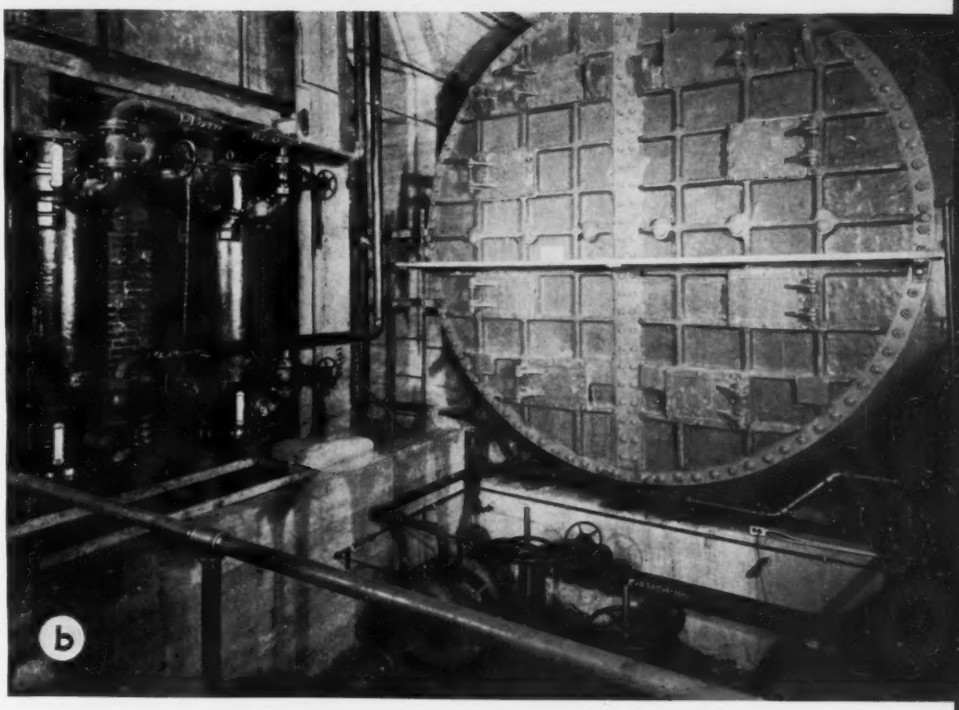
The fact that the side columns of the foundation must inclose the condenser called for a wider spacing than the conventional foundation, with the resulting longer and deeper cross beams to obtain the desired stiffness and rigidity. Space requirement necessitated the installation of intake and discharge piping between the foundation columns and property restrictions limited the over-all widths to 26 ft. Consequently, careful design was necessary to insure clearances and supports for the piping and the air coolers and to provide space for the leads and instrument transformers.

Due to the fact that certain pieces of apparatus were already installed, such as boiler feed pumps and deaerating heater, full advantage could not be taken of all the steam extraction points available. However, an inclosed heater on the eleventh stage was installed and provision was made for the addition of a similar heater on the eighth stage, with the present use of the eighth and fourth stage steam for the deaerating heater. Selection of the stage use was determined automatically, varying with load conditions.

The condenser construction was started immediately and parts shipped ahead of promised schedule and installed accordingly, completing the work in slightly less than four months from the placing of the order.

[*Continued on page 139*]

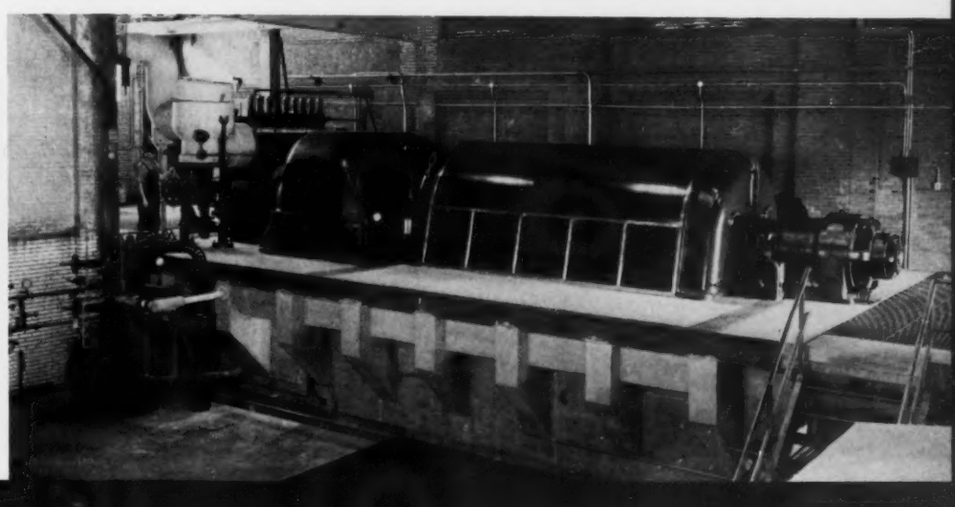




AMPLE WORKING SPACE available. (a) Instrument panel adjacent to valve chest end of turbo-generator. (b) Condenser is directly under the floor grating in the foreground of (a). The hotwell pump is in the foreground and the oil cooler at the left

ELEVATION OF UNIT above previous floor level necessitated by larger diameter of condenser than was used in conjunction with the machines on the former level

There is ample operating space around the machine. The air ejector at the left is connected to th condenser beneath the floor. By taking advantage of favorable circumstances, by beginning preliminar construction as soon as construction orders were placed and by synchronizing the erection moves to be advantage, it was possible to have a new 25,000-kva. unit running on the line less than five months fro the beginning of the work.



Series Capacitor Allows Heavier Welding Load

Doubled thickness of the stock being welded causes the current draw to rise above supply capacity. Power factor correction provides supply adequacy at lowest cost

L. G. LEVOY, Jr., General Electric Company

USE of series capacitors for power-factor correction of resistance welding machines is rapidly expanding and is proving very satisfactory on many installations now in service. The function of these capacitors is to reduce the instantaneous kva. demand by correcting the power factor. This results in a reduction in the voltage drop of the feeder, thereby minimizing or, in some cases, entirely eliminating the troublesome "flicker" problem. Sometimes the problem is one of obtaining sufficient power from an existing system without expensive reinforcement. Series capacitors provide a solution which, in many cases, is less expensive than otherwise reinforcing the system to serve the desired load.

The first production installation of this kind was made on a large resistance spot-welding machine located in one of the factory buildings of the General Electric Company at Schenectady, N. Y. This machine was equipped with a fully electronic pulsating spot-welding control. The welding transformer primary was made in two equal sections for either series or parallel connection and current control was obtained by phase control from the electronic panel. This machine was regularly used for the fabrication of $\frac{1}{8}$-in. aluminum sheets, using the series connection on the welding transformer primary.

Heavier Sheets

New production requirements made it desirable to fabricate $\frac{1}{4}$-in. aluminum sheets on this machine. However, the secondary current available was found to be inadequate. The primary connection was therefore changed from series to parallel. With this connection, however, it was found that the supply line breaker could not be set high enough to provide sufficient current for the desired weld, and the load was considerably in excess of the feeder rating. Consequent'y it became necessary either to reinforce the circuit supplying power or to reduce the welder kva. line demand.

The accompanying circuit diagram shows the arrangement of the circuit, substation transformers and oil circuit breakers in the circuit feeding power to this spot welder.

The following possible solutions were considered:

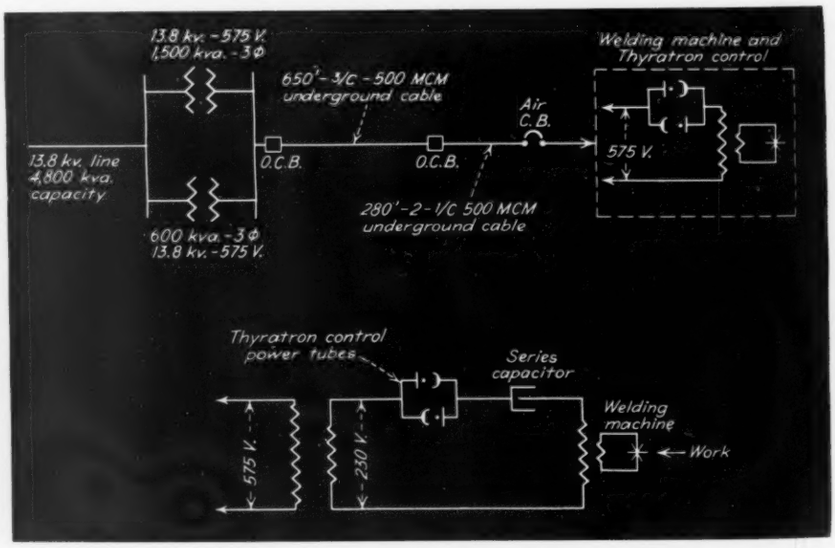
1. Install a suitable motor-generator set.
2. Build a new substation at another location closer to the welding machine, bringing the 13.8-kv. primary power to this substation.
3. Withdraw the existing cable and replace it with a concentric cable which would provide sufficient cable capacity to carry the demand of the welding machine. However, due to other loads on the substation transformers, they would be overloaded by this heavier demand necessitating additional transformer capacity together with suitable switching facilities.
4. Reduce the load by power-factor correction so that the existing feeder could handle it satisfactorily.

Lowest Cost Method

Preliminary calculations indicated that alternative (4) would be the least expensive and most satisfactory solution providing it was possible to use the existing feeder. The relative costs for the different methods were:

Alternative	Relative Cost
(1)	330 per cent
(2)	165 per cent
(3)	140-150 per cent
(4)	100 per cent

It should be noted that if alternative (3) had been used a bank of transformers and switchgear located



WELDER SUPPLY capacity increased by addition of series capacitor. Detail sketch shows revised welder circuit.

in another part of the plant could have been utilized to reinforce the existing substation. It was difficult, therefore, to make an accurate estimate of the actual cost to be allocated to this new job. An estimate was made, however, including (1) a reasonable value for the use of the old transformer bank, (2) moving and installing the transformers and switchgear and (3) replacing the existing cable. This estimate indicated that the total cost to be allocated to this job would be between 140 and 150 per cent of the cost of the series capacitor equipment.

The required impedance and power-factor measurements were made to determine the rating of the series capacitor. These measurements were made under a variety of conditions, including maximum, minimum and normal working throat depth, and also with work ranging from a direct short circuit of the electrodes to the highest resistivity samples that it was required to weld. As a result of these measurements a compromise value of capacitance was selected which would correct the machine to unity power factor in the average working throat position. Deviations from this average throat position would result in slight deviations of the corrected power factor from unity. Calculations of line demand indicated that the existing feeder would be adequate if series-capacitor power-factor correction was applied, as the demand would be below that formerly used to weld the lighter stock.

Since the welding machine and control were originally operating at 575 volts, it was desired to maintain essentially this same voltage on the welding machine and control, thereby requiring the minimum amount of change for voltage co-ordination of the series-capacitor system. This was desirable both from the standpoint of cost and speed with which the changes could be made.

Feeder Voltage Halved

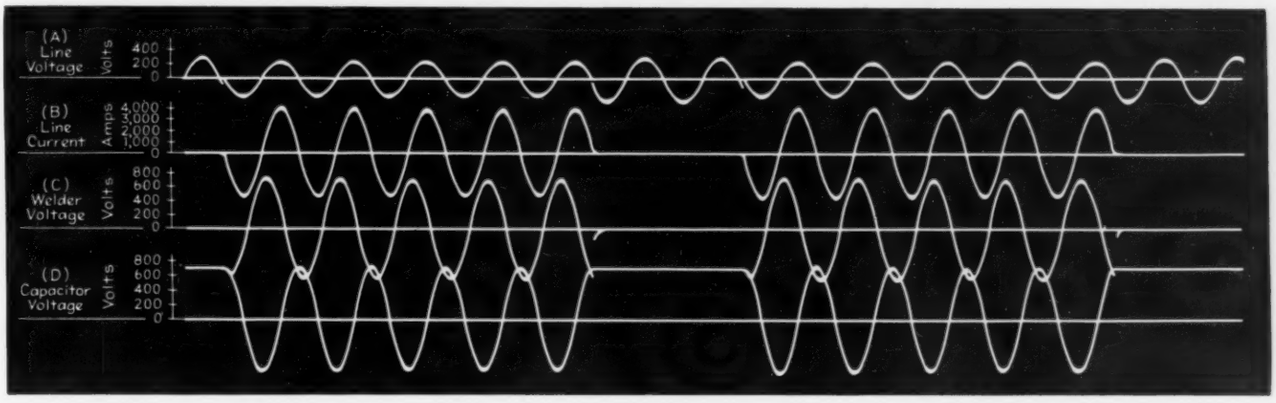
An old 575–115/230-volt distributor transformer was located and connected to reduce the original feeder voltage from 575 to 230, as shown in the diagram. The series capacitors were hung from the ceiling over the machine to avoid using floor space. In addition the control panel was modified by adjusting the phase shift network to operate over the correct range for a power-factor-corrected welding machine, and the grid bias voltages were changed to accommodate operation with a series capacitor. The system was placed in operation and found to provide adequate power for welding the ¼-in. aluminum stock as required, with no changes in the line feeder or breaker settings. The oscillogram of a portion of a pulsating spot weld made on the ¼-in. aluminum stock shows the present circuit conditions.

The oscillogram is of particular interest in that it shows both the line kva. and welding transformer kva. requirements, so that the comparison of line requirements both for a corrected and uncorrected welding machine can be made directly.

The product of traces (A) and (B) give the line demand for the power-factor-corrected machine. In this case the line demand is 520 kva. The product of traces (B) and (C) give the welding transformer input, which is 1,400 kva., or a gain of 2.7 to 1 in the line demand for the power-factor-corrected machine as compared with the uncorrected machine. In addition, comparison of the phase relations of traces (A) and (B) and traces (B) and (C) show that there is a power-factor improvement from about 36 per cent lagging to practically unity power factor (97 per cent).

Correction was not made to exactly unity power factor for this particular throat setting, since a compromise capacitor was installed, as explained.

It will be observed that the 230-volt line voltage trace shows a voltage drop of approximately 20 per cent. A large part of this drop occurs in the small distribution transformer, which is considered as a temporary expedient. This transformer will be replaced with an auto-transformer which will be smaller physically but will have improved regulation. It is also interesting to note that the series capacitor is left with exactly the proper charge at the end of each spot, so that the succeeding spot begins without transient.



OSCILLOGRAM shows effect of series capacitor in welder circuit

The system here described has been in continuous operation on a production job approximately one year and has proved satisfactory in every respect. It is hoped that this may serve as a guide to future applications where the installation of series capacitors will simplify the power supply problem. On new installations the total cost will be less, since the cost of voltage co-ordination and control circuit changes could be avoided by proper selection of equipment for use with series capacitors.

The most economic solution will vary with the particular circumstances of the problem, hence it is recommended that in all cases an economic comparison of the possible methods of solution be made in order that the best solution can be selected.

Live Line Maintenance Helps Handle "The Growing Load"

Proper use of "hot sticks" permits variety of maintenance work on voltages from 6.9 to 220 kv. to be done safely and economically

D. C. HUBBARD, Chief of Research, A. B. Chance Company

1. STRAIN CARRIER—On this 66-kv. line the rectangular affair at right is a strain carrier. Insulators are suspended in an insulated cradle, which is in turn suspended from an insulated swinging boom. (Some of the linemen are kibitzers.)

2. TRANSFORMER MOUNTING—On this typical REA construction the phase wire has been moved aside to permit the mounting of a transformer at a new load. How this technique may be used on other rural construction jobs is shown in (3) and (5).

3. INSULATOR REPLACEMENT—At this rural dead-end corner pole a strain tool was applied to provide sufficient slack so that a defective insulator could be removed. A new insulator is about to be installed. Dead-end clamp is securely engaged by the tool and a safety latch prevents the clamp from getting away.

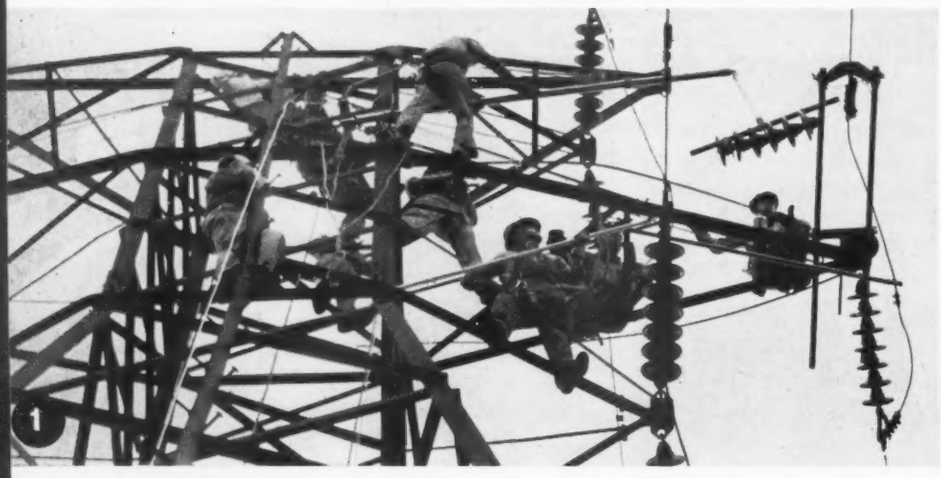
4. 33-KV. STRUCTURE—Insulators on this pin-type structure are being replaced. A telephone circuit has also been pulled aside to allow better working conditions and will be pulled back into place with insulated tools.

5. NEW CROSSARM—All four wires on this typical rural construction were set aside to permit the installation of a new crossarm.

6. INSULATOR CHANGEOVER—Changing over to glass insulators on a 44-kv. suspension pole structure. Lower-voltage conductors at right of bottom crossarm have been set aside to provide ample climbing space, while one conductor at the left has been removed to allow clearance for the hand line.

7. DEAD-END CHANGE-OUT—Note that the lineman does not handle the 33-kv. insulators until after they have been taken away from energized parts.

8. 110 KV.—In this changing of suspension insulators a replacement string is being lowered into position while the line conductor is supported by tools.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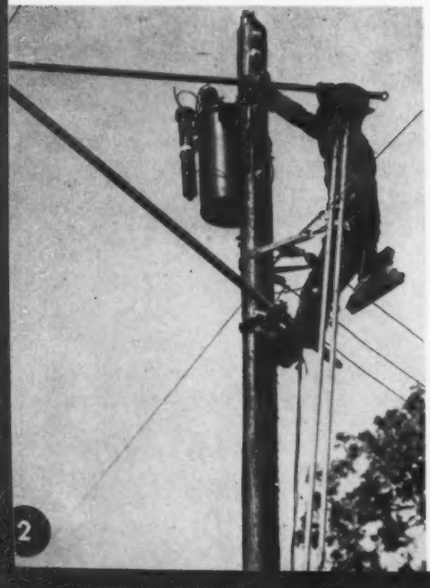
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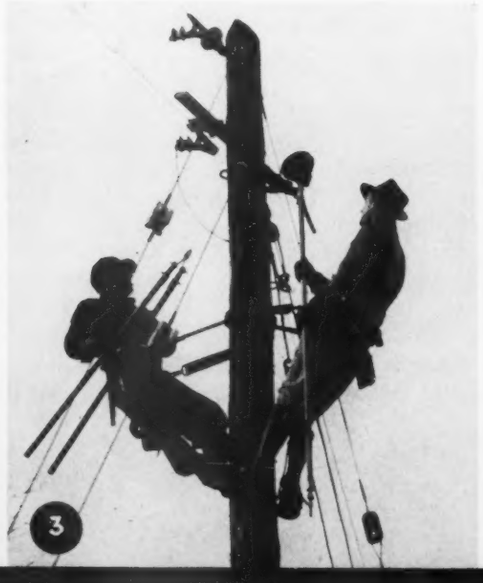
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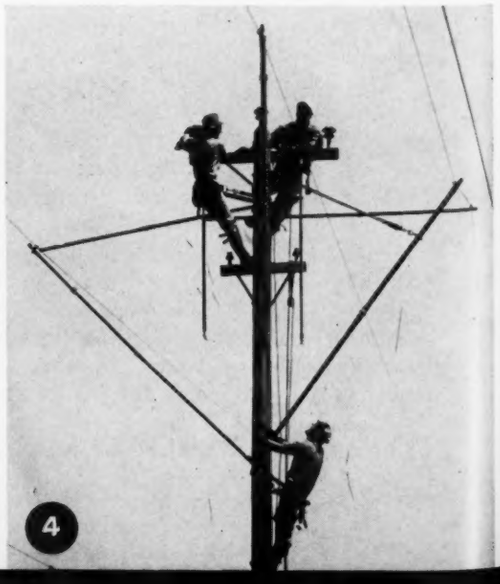
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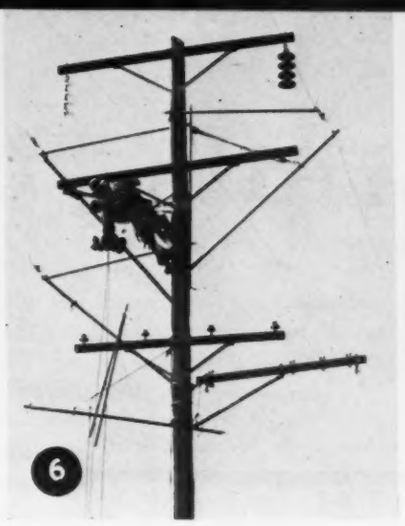
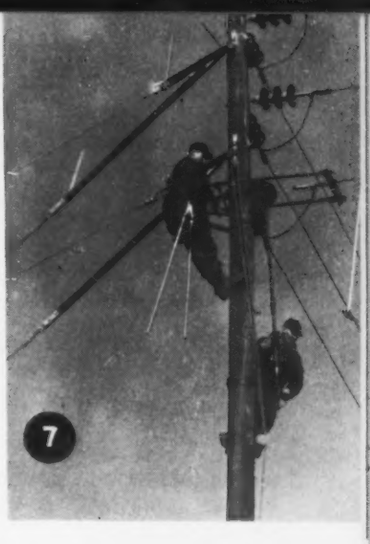
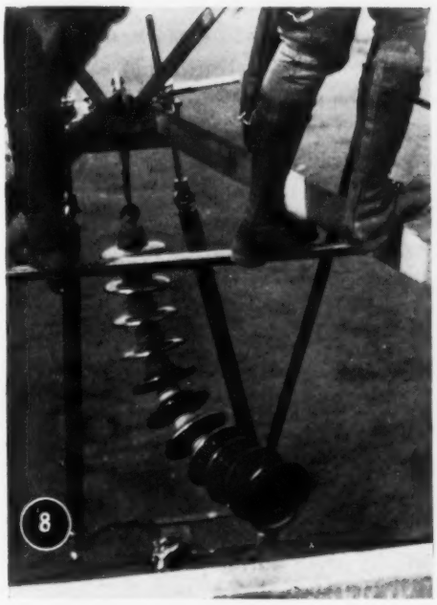
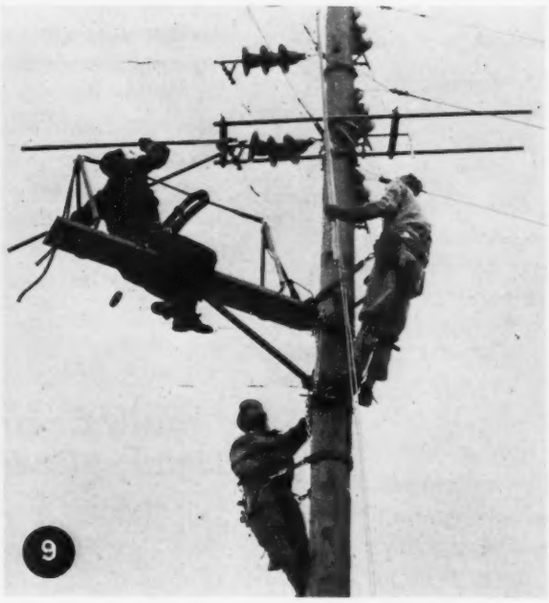
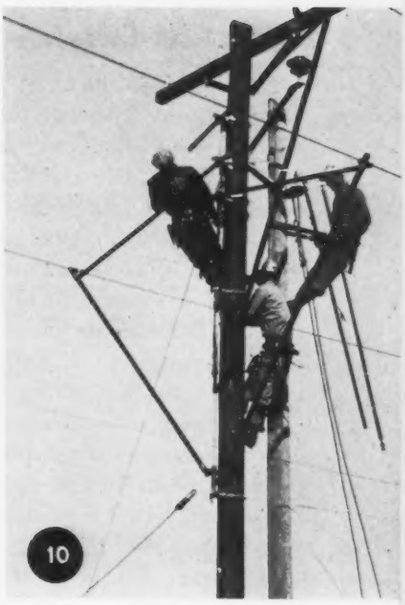










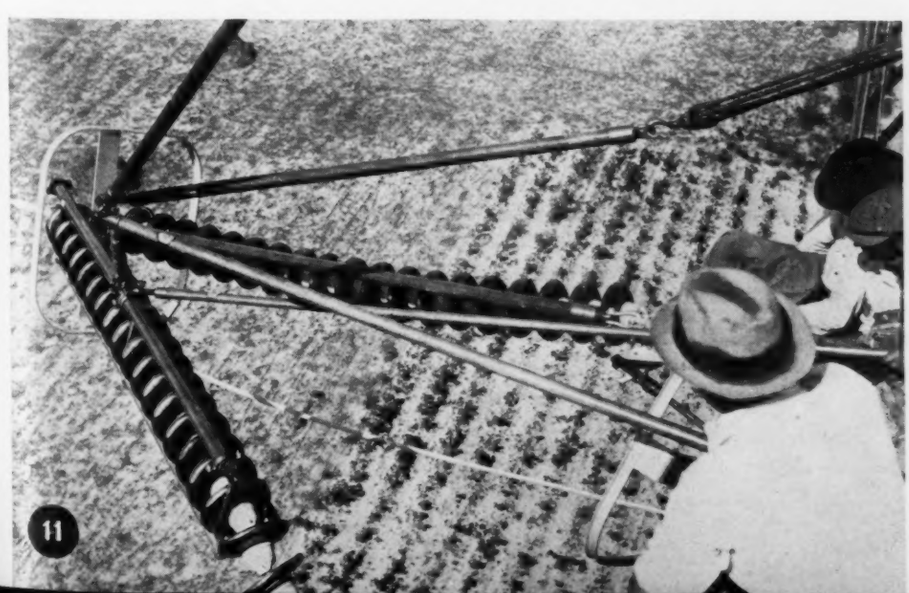
9. INSULATED PLATFORM has many uses, one of which is here shown. While the lineman appears to be directly under the conductor, he is really out to one side.

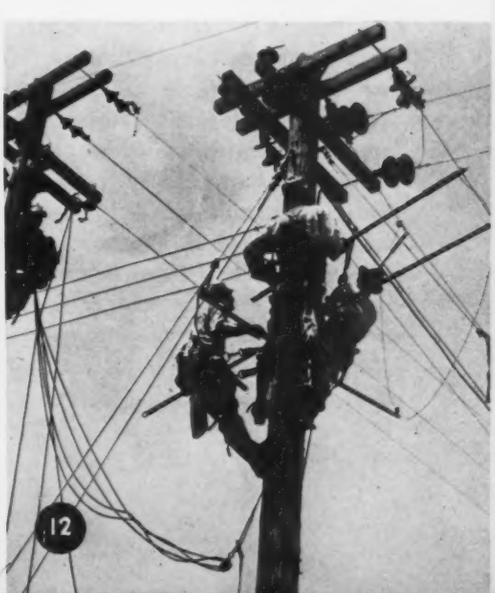
10. LINE REBUILDING—In this example of a complete line rebuilt "hot" new poles were set and the old steel wishbones were replaced by wood arms and wood braces.

11. HANDLING A DOUBLE STRING—Close-up of 19-unit string shows one method used where double strings are employed. In the foreground is the swinging boom supporting a heavy-duty insulator cradle. Running along side of the unit in the background is a single-pole fork-type strain carrier that engages the forward yoke plate.

Seen below the man in the foreground is a strain jack controlling the action of the rear yoke plate.

12. LINE RELOCATION — Corner pole involved in relocation of a loop feeder line to a city of approximately 15,000. Circuit supplied two hospitals, railroad yard and a sizable industrial load. Entire job was done "hot," including splicing of additional length to the conductors as shown.





Editorials

S. B. WILLIAMS, *Editor*

Effect of Defense Load

WHAT has been the effect of the defense load upon our electric utility systems? The weekly reports show the energy consumption, but what of peaks and capacity and of utilization, plant and load factors? All of these are needed to get a fair picture of current conditions.

These data for 1940 are contained in the insert in this issue. This is ELECTRICAL WORLD's 29th annual survey of one-hundred-million kilowatt-hour systems. It includes 186 separate generating systems (electric utility and transportation) in North America, of which 155 are power companies operating in the United States.

Using only the nameplate ratings of the plants actually in operation at the time of peak, we find that the generator peaks were protected by a reserve of more than 27 per cent. This is substantially the system figure of 30 per cent reported by E.E.I. for December.

Consumption is growing faster than net capacity additions, which means that utilization factors are higher. The interesting point here is the number of systems with utilization factors in excess of 100 per cent. Obviously, then, a plain comparison of nameplate rating and demand is not necessarily an indication of capacity adequacy. Thus the effective capacity is some higher figure than the summation of nameplate ratings.

In 1915 and 1916, when the United States was first acting as the arsenal of democracy, the load factor declined with increasing demand. In 1940, on the other hand, load factor was improved. This reflection of longer hours of industrial operation should be more pronounced in 1941 under OPM's plan for more shifts.

These figures further support the contention that there will be no power shortage that can be laid at the door of the utilities.

In presenting this 29th survey of North America's largest systems, we want to express our appreciation for the continued co-operation of these 186 companies, particularly at a time when they are so busy. For twenty-eight years the largest systems of North America have been co-operating with ELECTRICAL WORLD in the preparation of this survey, which is probably the oldest annual statistical survey in the industry. We hope it provides information and inspiration to a degree that warrants the effort of these companies.

Status of Utility Association Member Companies

A LETTER sent last week by the director of the public utilities division of SEC to the president of E.E.I. should allay the fears of any company not otherwise subject to SEC regulation that membership in a registered association would bring the company under the jurisdiction of the commission.

Not only is there nothing that would change the jurisdictional status of a member company, the letter states, but no proceedings that might put any other construction on the act is being considered. And, in fact, if any such proceedings were instituted appropriate notice and opportunity for hearings would have to be given. At that time any member company could remove itself from the proceedings by resigning from the association.

While there is no denying the fact that this is an informal opinion of a staff member and not a commission decision, it can be taken for granted that the letter was never sent out without the notice of the commission.

There is nothing, therefore, for member companies to fear as the result of association registration other than the possible loss of benefits that accrue from membership.

Legally Enforceable Lighting Codes

THE SUGGESTION was made at a recent meeting that vision should be protected by law through legally enforceable codes. To indicate the need for such codes it was stated that in addition to the 140,000 people in the United States who are incurably blind each year adds some 60,000 people whose vision has gone below the safety level.

A large percentage of these people would not suffer loss of vision if the lighting under which they use their eyes was adequate for the task. Codes covering street and highway lighting, school lighting and industrial lighting are now available and an office lighting code is in preparation. These were all written by committees of the Illuminating Engineering Society.

Although some of these codes are A.S.A. approved, none of them have the stamp of legal authority. Nor are they likely to find their way into ordinances because they are not "minimums" accepted in conference by all interests. Values arrived at through such conferences might permit people to see, but would not protect vision.

It is for that reason that the I.E.S. now calls its codes "recommended practices." The levels of illumination that are recommended are not compromises of commercial interests. They are values which engineers recommend as best for vision, having in mind commercially available light sources.

Certainly there is sufficient public hazard to warrant legally enforceable lighting codes, but so long as employer groups and municipal councils are more swayed by the

element of first cost than by the element of long-time saving, let alone the social aspect, just so long must we rely on the slower process of education. Codes of low standards are worse than no code at all.

Income Taxes and the Appliance Market

IT IS DIFFICULT to know how to interpret the effects of the proposed new income tax if the levy and method of levy remains approximately as reported last week. By not reducing further the basic exemptions, the implication is that labor is to be allowed full opportunity to spend its improved income as it pleases. That should mean an increased market for residential electrical equipment. In fact, it is here now.

Where are the materials coming from, however, especially as each day brings new problems in raw materials? Then if there is to be difficulty in getting enough to supply this increased demand caused by labor with more money in its pockets, the obvious result would be price snowballing. The government, however, has decreed price control to prevent this very thing from happening.

One group in Washington is urging an increase in production of non-military goods as a means of preventing inflation. The OPM, on the other hand, is restricting critical materials and calling for the use of longer hours of production facilities on defense materials. Surely they can't both be right.

Our guess is that for the time being at least there may be very little curtailment in the production of electrical appliances, but there is some reason to question that there shall be any substantial expansion.

The Bell Tolls for 'Quoddy

A TIDAL POWER PLANT at Passamaquoddy is economically infeasible now or for a long time, according to a report to the Senate by the chief engineer for the Federal Power Commission. It must not be assumed, however, that the idea of harnessing the tides has been abandoned.

In fact, the report suggests an international project in the Bay of Fundy area. The reason why such a project might be economically feasible is that a naval base might be built there. Thus a way would be found to unload the costs of developing tidal power. The Tennessee and Columbia rivers were economically feasible only when navigation could be made to carry a large part of the burden. That the navigation was of theoretical value only is beside the point.

The same thing is true of the St. Lawrence. An equal amount of steam power can be located closer to the load for less money than is even now proposed for St. Lawrence, to say nothing of less time. That will not make the international project economically infeasible because navigation improvement will help to carry the load.

Anything can be made economically feasible if a sufficient part of the cost can be repudiated, written off or dumped into some other account. Even 'Quoddy could have pulled through if some public improvement had been found on which 50 per cent or more of the cost could have been saddled.

The Name on the Door

MANY a man has received in lieu of an increase in salary a private office with a rug on the floor and his name on the door. Is that what the owners of the privately operated electric utilities are coming to?

A few weeks ago the Consolidated Edison Company in a well-designed report to employees on its 1940 business stated that the investors received $55,190,000 return from their holdings, while government took in taxes $58,521,000.

These ratios may not hold for every company, but the unescapable fact is that government more and more is getting the fruits of the enterprise. And as the needs of government get greater and greater, one will soon begin to wonder if perhaps this isn't really government ownership, the only difference being that the investors are permitted to have their name on the door.

Rights of Cities to Our Street Occupancy

AN INTERESTING DECISION covering the rights of a city that has refused to renew a utility franchise was handed down last month by the Illinois Supreme Court. Two small communities, Geneseo with a population of 3,400 and Heyworth with a population just under a thousand, and both with municipal plants, denied franchise renewals to private companies and ordered these companies to remove their equipment from the city streets. Lower courts and the state Commerce Commission decided against the cities, but the state Supreme Court has overruled, holding that cities have complete right over the use and occupancy of city streets and alleys.

Where does that leave a utility that has been serving a community for a long time? There is little bargaining advantage left in event of a proposed sale. To take the property out of the streets may in some cases involve an expense almost equal to the material recovery value, especially if lines have been up a long time.

Such occurrences give added weight to recapture clauses in event of forfeiture of franchise. The idea that recapture clauses are too constant a reminder of possible public ownership would seem to be a rather expensive luxury to indulge in if the above decision has wide application.

Government Ownership Takes Precedence Over Defense

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

AN INQUIRING REPORTER from Mars, studying the Washington situation today, would be enormously intrigued by priorities.

Particularly priorities as to objectives.

If he judged by surface actions, as distinguished from conversation, he would probably list them in his dispatch about as follows:

1. Spread of the "blessings" of public power.
2. Enforcement of all existing "reform" legislation, particularly laws tending to handicap corporations engaged in national defense activities.
3. Verbal irritation of Hitler.
4. National defense effort.

Aluminum Situation

He would be amazed, probably, at the aluminum situation. Aluminum is just about tops in national defense needs, because it is so vital in airplanes. The story has already been told in this column of the Aluminum Company's offer to construct a big addition to its plant near Bonneville, and of the rejection of that proposal by Secretary of the Interior and Public Power Overlord Harold L. Ickes on the ground that this would commit too large a percentage of Bonneville's power! And this despite considerable worry for a long time past about how consumers for Bonneville power could be brought within an economic radius!

More recently the Aluminum Company has been blocked in an equally curious way, this time at Messina, New York. The company was negotiating for a large block of Canadian power. Washington stepped in with a veto. It is worth noting at this point that the Canadian government has become an eager echo to anything Washington wants—for the time being. With Uncle Sam taking up so much of the Canadian financial strain, why wouldn't it? The interesting point is why Washington wanted to stop a company anxious to produce vitally needed aluminum from getting power from Canada. Could it be possible that such a deal would prick the "power shortage" bubble in northern New York now being dangled before Congress in the expectancy of getting an appropriation for the St. Lawrence Seaway?

Of course the Administration claims that the seaway is necessary for national defense—that its operation seven years hence, the earliest moment it could be completed, will be vital to prosecution of this war.

"Riddle me that one," as John L. Lewis likes to say when he is sure you do not have the answer.

Turbines

Then there is the matter of turbines. Due partially to the fact that the Allis-Chalmers strike was allowed to last so long, but also to the fact that turbine capacity is strictly limited, every one knows there is no surplus capacity for producing these tremendously necessary mechanisms. They are needed for destroyers, the worst foes of submarines and the best guardians for battleships. They are needed for battleships. They are needed for steam-electric generators.

President Roosevelt is acutely aware of this. Talking recently about the St. Lawrence Seaway project, he said it was vital to national defense because we must save our turbines for territory not close to hydro projects!

So Harold Ickes sends to Congress a request for an original $4,000,000 appropriation to start work on a $15,000,000 steam plant to firm the power to be generated by the Shasta hydro plant. Leaving to one side the fact that this would take turbines vitally needed for defense work, consider the economics of the situation. Pacific Gas & Electric had offered to market the Shasta power, using its own existing steam plants to firm it. It offered, in testimony before a House committee, to let the Federal Power Commission or the California Railroad Commission *fix the price!*

That proposal would seem calculated to save the government unnecessary spending, and to release turbines for more vital purposes—*but*—how about the priorities?

Obviously it would delay the spread of the blessings of public power. One might think that the people would rather see a few more destroyers hunting submarines and making sure Hitler was beaten, and wait until the war was over for the further spread of public power blessings. But then the people are not deciding. It is Ickes, and Cohen, and Norris and Rankin, apparently with the backing of FDR, who are deciding. And they are deciding absolutely according to the priorities which the reporter from Mars could ascertain.

Here is John Rankin, head of the public power bloc in the House of Representatives, pushing not only for the once famous "Seven TVA's again, but for a generating plant for Mississippi REA power. The Mars reporter would find it difficult to believe that a war was going on, and that Rankin was publicly backing Roosevelt in every inching step toward it.

Rural Generating Plants

He would be even more surprised, if he went into that situation, to find that although Harry Slattery, director of REA, has boosted operations of that agency from 115,000 miles on July 1, 1939, to 281,000 miles on March 1, 1941, there are more than murmurs inside the public power bloc against him. They don't like his opposition to generating plants as a feature of REA. They don't like some of his other ideas. He lacks, as they see it, the forthright anti-corporation slant of his predecessor.

Wonder what that editor up in Mars would think when he read his reporter's dispatch?

"If that devil must fake to justify an expense account," he would probably say, "why the Sam Hill doesn't he fake something *probable*?"

NEWS OF THE WEEK

North American Plans to Liquidate Holdings

President Shea tells stockholders at annual meeting that company must divest interest in subsidiaries under "death sentence" of utility act — Plans to invest in other fields

With a long list of accomplishments behind its 51 years of utility operations, North American Co. must now liquidate under the terms of the "death sentence" of the utility act, President Edward L. Shea told stockholders at their annual meeting in New York last week.

Your company has long been recognized as a leader in the electric power industry and has helped to bring better standards of living and better homes to millions of our people and has made an outstanding contribution to the development of important industrial areas, Mr. Shea told the assembled stockholders.

$100,000,000 Program

"As the national emergency arose, the North American system, through foresighted planning, was already well started on a program to invest more than $100,000,000 in order to be fully prepared to meet all the demands which the program to defend the nation might make upon its facilities," he declared.

Uppermost in the minds of the stockholders was the value of their stocks in the break-up of the system. Mr. Shea said that stocks of the operating companies could be distributed pro rata were it not for outstanding debentures and preferred stock of North American. As a practical matter, he declared, any program for complying with the anticipated order of the SEC must first provide for the realization of investments to the extent necessary to provide for the retirement of the debentures and preferred stock.

Mr. Shea said that if investments in subsidiaries could be sold on the basis of twelve times earnings, then North American common would represent a value of over $21 a share. What can be realized for the common stock depends on the period of time the SEC allows for sale of sufficient investments in subsidiaries to pay off North American senior securities, upon the market conditions prevailing during that time and on the conditions under which the SEC may permit to effect the sales.

"I am sure that I reflect the views of the management when I say that there is no desire whatsoever to perpetuate the existence of the North American Co. unless it serves a really useful purpose, such as it has during the past 51 years," Mr. Shea said. "We cannot now see how the company could serve any important purpose as a public utility holding company if its investments

ANNUAL MEETING—Stockholders sat in "dead silence" as President Edward L. Shea related how the "death sentence" of the utility act meant the liquidation of North American Co. At the table (l. to r.) court reporter; Reed Hartel, secretary; Mr. Shea, James F. Fogarty, chairman of the executive committee, and H. C. Freeman, vice-president. Mr. Fogarty is seen shaking hands with John C. Barnes of Branford, Conn., a stockholder for more than 35 years, at the annual meeting

INITIAL LIGHT-OFF—Boiler No. 1 at Commonwealth Edison Company's Northwest station, one of three high-pressure boilers included in the company's program of expansion for this plant, was "lighted-off" recently in presence of chief operating engineer, A. D. Bailey, A. E. Grunert, superintendent of generating stations, and chief engineer, W. I. Evans of Northwest, together with a group of operating men and manufacturers' representatives

were restricted to only one of the four major properties. Under such conditions we would undoubtedly recommend the dissolution of the company."

Mr. Shea told the stockholders that when the company had divested itself of control of all its public utility operating companies by sale, distribution or otherwise, and has ceased to be a holding company, the public interest may be greatly served by the company continuing to have available a substantial amount of capital for investment in other fields.

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Weiner Quits SEC Post to Join OPACS

Joseph L. Weiner, director of the public utilities division of the Securities and Exchange Commission, has resigned to become head of one of the three divisions in the Office of Price Administration and Civilian Supply under Leon Henderson. Mr. Weiner will direct the division which allocates scarce materials among non-defense consumers.

The resignation of Mr. Weiner is more than significant, for the aggressive enforcement of the utility holding company act, the strict interpretation of the "death sentence" provision and the starting of proceedings to disintegrate the large systems date from the elevation of Mr. Weiner to head of the division in July, 1939.

Under Mr. Weiner's leadership the utility division has sponsored and the SEC has adopted (1) integration "blueprint" orders against holding companies, (2) competitive bidding for underwriting of utility securities, (3) a policy of insisting upon common stock financing by heavily indebted operating companies, (4) limited divorcement of service companies from holding companies, (5) regulation of intercompany loans, and (6) supervision of market dealings by utilities in their own securities.

The SEC disclosed that Robert H. O'Brien was appointed successor to Mr. Weiner and that George Rosier and John W. Houser were appointed assistant directors of the utilities division. The position of associated director of the division, heretofore held by Mr. O'Brien, has been abolished.

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Pacific Gas & Electric Plants Opposed by Ickes

Secretary Ickes has urged the Federal Power Commission not to permit private electric companies in northern California to "fester an uneconomic and archaic power market by constructing spite plants."

Mr. Ickes wrote the commission urging cancellation of a license issued February 19 to Pacific Gas & Electric Co. for construction of a $19,000,000 hydro development on the Feather River. He said his department was drafting legislation for establishment of a federal agency for marketing public power in northern California.

NEWS BRIEFS

SECRETARY ICKES hints a rate reduction for Bonneville-Grand Coulee as he urges Tacoma to postpone a proposed $11,000,000 expansion of its municipal system.

PRESENTED WITH a framed resolution drawing attention to his accomplishments, Merrill E. Skinner, vice-president of Buffalo Niagara Electric Corp. and past-president of the Electric Association of the Niagara Frontier, was honored by the association's board of directors.

ELECTRICITY CONSUMED by broadcasting stations is subject to the 3 per cent state sales tax, Attorney-General Leo A. Temmy of South Dakota has ruled. Radio waves, he said, are a separate commodity from electricity.

THE LEGAL DEPARTMENT of Metropolitan Edison Co., Reading, Pa., has been closed out, Chief Counsel Harold J. Ryan returning to private practice.

BOSTON EDISON CO. has received a Rear-Admiral's thanks for co-operation in supplying cable from its reserve capacity in connection with a recent tunnel fire at the Boston Navy Yard. Although not a direct customer of Boston Edison, the yard received service from Edison crews and supplies which minimized the resulting shutdown, all of which was highly appreciated by Commandant W. T. Tarrant in a communication to the utility.

New Boiler Gives Jersey Utility Added Capacity

Jersey Central Power & Light ups construction program to $3,001,149 for this year with major projects on distribution system — New boiler in Raritan River station adds 15,000 kw.

Major construction in the distribution system will be undertaken by Jersey Central Power & Light Co., which has upped its 1941 construction program to $3,001,149 from $1,906,449 spent last year. The company has allocated $1,051,500 to distribution system work.

This year the company will complete the installation of a boiler which will add 15,000 kw. capacity to the Raritan River station. It is expected that it will be ready for operation next November, T. R. Crumley, president and general manager, said.

Allocation of the construction budget follows:

Building Budget

	1941	1940
Steam power stations	$952,553	$46,947
Transmission lines	125,500	167,109
Substations	189,500	747,684
Distribution system	1,051,500	246,504
Miscellaneous	87,470	103,578
Maintenance	594,626	594,627
Total	$3,001,149	$1,906,449

Last year the company constructed 40 miles of rural lines and added 405 customers. This year the company contemplates the construction of 25 miles of rural lines and will add 325 customers.

Total dollar volume of appliance sales during load-building campaigns in 1940 was $946,520 and this year sales are expected to reach $955,000. The objective gain in the average annual use of electricity for residential customers this year is 52 kw.-hr.

Continuing studies of substation loading and circuit loading to anticipate increased demands on any of the substations or circuits are being made by the company. New regulators have been purchased and others transferred to substations of small capacities. It was stated that new transformers have been purchased and will be installed as required.

Protective Measures

For protective measures against possible sabotage the company has built fencing, installed floodlighting and issued identification passes to employees and to outside contractors engaged in construction work at company plants.

It was stated that the company does not anticipate that the defense effort will cause any abnormal increases in load. The probable demand has been studied and arrangements made for increased substation and transformer capacities. The increased generating capacity of 15,000 kw. to be completed next November is expected to insure the company against any possible power shortage.

W. H. Baldwin, assistant to the president, stated that the company plans to employ and train guards for protection of major plants as part of a program of employees' emergency training for home defense.

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Tax Clause Rejected by Bay State Board

The Massachusetts Department of Public Utilities has dismissed a petition of the Lawrence Gas & Electric Co. for the right to insert a tax clause in its gas rates based on an advance of one-tenth of 1 per cent for each mill of tax increase above 19 cents per dollar of total revenue and a corresponding reduction below 19 cents.

The commission reached this decision on the ground that the proposed tax clause would be tantamount to a rate increase under present conditions and that it would deprive the company of the incentive to seek lower taxation and reduce its expenses by increasing its sales and lowering its operation costs. However, the board recognized the imminence of heavy taxation advances in utility operation as a result of financing the defense program and stated that in the event of tax increases, making more revenue necessary, the company may file revised schedules of rates for consideration by the commission.

It is expected that other similar applications before the board will be refused on the foregoing basis, but with the proviso applying to the Lawrence situation.

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Settle Area Dispute

The Pennsylvania Power & Light Co. and the Adams Electric Co-operative, Inc., have reached an agreement, which has been approved by the Public Utility Commission, in the dispute involving which shall serve farm customers in Cumberland County. The dispute broke out last January 30, in the "battle of shovels," when farmers desiring to be served by the REA co-operative uprooted utility poles as fast as they were erected. The agreement was reached following lengthy hearings before the commission.

UTILITY GUARDSMEN DEPART—Vice-President A. G. deClercq, Commonwealth Edison, bids farewell to Major J. C. Fitch of the company's construction department as Company B, 108th Engineers, entrain for Camp Forrest. Lieutenant R. A. Hirshfield, engineering department (left), and Louis A. Ferguson, Jr. (right) look on. Up to March 24, a total of 204 men of the Chicago company were on active Army duty

Carolina Power & Light Adds $3,000,000 Budget

President Sutton says company will spend $8,500,000 in two years to expand Cape Fear plant — Two 40,000-hp. units and boilers to be installed in defense plant expansion

Another $3,000,000 addition to the Carolina Power & Light Company's Cape Fear steam-electric generating plant has been authorized by directors at a special meeting called to map plans for further co-operation in the national defense program, according to L. V. Sutton, president and general manager.

The board, which approved plans last January for a $3,000,000 addition to the Cape Fear plant, located 27 miles southwest of Raleigh, went fully into the company's plans for co-operation with the defense program and also to take care of anticipated increased demands for electric service in the territory served in North and South Carolina before approving the construction program, Mr. Sutton said. Each of the new units will be of 40,000 hp. capacity.

Transmission Lines

In addition to the new plant addition, Mr. Sutton said, the directors approved plans for the construction of five 110,000-volt transmission lines. In North Carolina new lines will be built from Selma to Goldsboro, from Goldsboro to Wilson and from Cape Fear plant to Erwin, while in South Carolina additional lines will be built from Florence to Greeleyville and from Hartsville to Chesterfield. These lines go into service this fall.

In preparing for what was termed an "all-out" program for defense, directors approved plans for new substations, improvements to present substations, high-speed relays, increased capacities of existing substations, and other improvements.

"Our company desires to co-operate to the fullest extent with the national defense program, and we have—and are—supplying many essential defense industries and Army bases with the electric power they need," Mr. Sutton declared.

The budget approved increases made earlier in the year and calls for a total expenditure of more than $8,500,000 during this and next year.

Both of the new units at Cape Fear are scheduled to be ready for service next year, one in April and the other in August. When placed in service the installed capacity of the plant will be increased to 124,000 hp. Orders were placed with Westinghouse Electric & Manufacturing Co. for the two units, designed for 850 lb. and 900 deg. The generators will be hydrogen cooled and the boilers will be of the semi-outdoor type, with each designed for 300,000 lb. or more of steam per hour.

Mr. Sutton pointed out that in addition to having ample power facilities at the present time to supply the needs of the territory served, his company in enlarging the Cape Fear plant to almost three times its present capacity is following a long-established policy of building in advance of territorial needs for more electric service.

Carolina Power & Light supplies power to Fort Bragg and is furnishing Tidewater Power Co. with a large portion of its power requirements—Tidewater supplies a number of Army and Marine bases and shipyards in its territory.

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Court Rejects Ruling of Wisconsin Tax Board

Wisconsin Supreme court has reversed a ruling by Circuit Court Judge A. C. Hoppmann concerning the five Wisconsin subsidiaries of the Northern States Power Co. of Delaware. The high court ruled that the old state tax commission did not have the power to combine the incomes of the firms for tax purposes and sent the case back to the tax department for further proceedings.

The companies had filed separate income returns and admitted taxes due to the sum of $53,736, for 1930-33 inclusive. The tax commission made an assessment of $367,230.

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FPC Issues Report on Electric Utilities

The Federal Power Commission has issued a 500-page volume of statistics of the electric utilities for the year ended December 31, 1939. It shows that the 383 electric utilities listed had total assets on their books of $17,179,662,571, aggregate utility plant accounts of $14,114,694,612 and outstanding securities of $13,454,627,347. Book investment in property represented $5.33 per dollar of annual revenue.

FPC stated that the report furnishes a basis for the development of cost and management standards, through permitting the comparison of virtually every characteristic of a company's operating or financial practices and results with corresponding factors of any other company. The report may be purchased from FPC, Washington, D.C., at $2 a copy.

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Two Cities Decline to Buy Utilities

Edgerton and Darlington voters emphatically rejected proposals for putting their cities into the electric service business by purchase of utility properties when the plans were submitted to them in special referendum elections recently held.

Edgerton voted 843 to 594 against a proposal to continue acquisition proceedings started in 1933, when the sentiment for municipal ownership was indicated by a vote of nearly twelve to one in favor of starting the proceedings.

At Darlington the vote was 625 to 265 against starting a new acquisition proceeding. The vote in Darlington was another upset, since in 1934 a referendum authorizing the start of an acquisition proceeding carried by a vote of five to one, and the following spring the decision was reaffirmed by a vote of seven to one.

When these first votes were taken the property was owned by the Darlington Electric Co., which sold to the Wisconsin Power & Light Co. After a three-year trial of the service of the new owner the City Council voted to discontinue the proceedings and the property was merged with that of the power company.

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Propose Hydro Project on Colorado River

A report has been sent to the Congress and to President Roosevelt by Secretary Ickes recommending construction of a "multi-purpose power and irrigation dam" on the Colorado River 67 miles downstream from Boulder Dam, at a cost of $41,200,000.

To be known as the Bullshead Dam, the project is to meet growing population needs and national defense requirements in the region, Mr. Ickes said. An appropriation of $5,000,000 is sought to begin construction work on the project, which will have a power capacity of 225,000 kw.

Show 51,154,523 hp. in Factory Capacity

Industries engaged in manufacturing reported a prime-mover installation at the close of 1939 aggregating 21,266,557 hp., a gain of 1,111,160 hp., or 5.5 per cent, since 1929, when the last census was made, according to acting Director Vergil D. Reed, Bureau of the Census. Industries reported 29,887,966 hp. for electric motors driven by purchased energy, a gain of 31.2 per cent over 22,775,664 hp. reported for such motors ten years ago.

Despite the aggregate gain in prime-mover horsepower, it was said, the number of establishments using power equipment totaled only 181,000 in 1939, as against 193,969 ten years ago, a decrease of 6.7 per cent. There were 183,277 factories in 1939, compared with 210,959 in 1929.

The greatest increase in prime-mover installation was reported for steam turbines, which increased by 3,564,826 hp., or 46.1 per cent. On the other hand, the steam-engine installation in these establishments decreased by 3,066,675 hp., or 31.9 per cent. Internal combustion engines increased by 568,958 hp., or 46.1 per cent, while hydro-turbines and water wheels showed only a slight increase of 44,051 hp., or 2.9 per cent.

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Hawaiian Electric Orders 35,000-Kw. Turbo-Generator

Hawaiian Electric Co., Ltd., Honolulu, has awarded a contract to Westinghouse for the largest turbine generator in Hawaii. The unit will be a 35,000-kw. at 0.80 power factor, 43,750 kw. at unity power factor, hydrogen-cooled tandem machine to be placed in service in the Bishop Street station for operation early in 1943. Steam will be 650 lb., 900 deg. The unit will be cross-tied to boilers already in the station.

The 3,600-r.p.m. generator will have a new type of flexibly mounted stator core, similar to that utilized recently for large turbine-generator units. It will be the only hydrogen-cooled machine on the islands.

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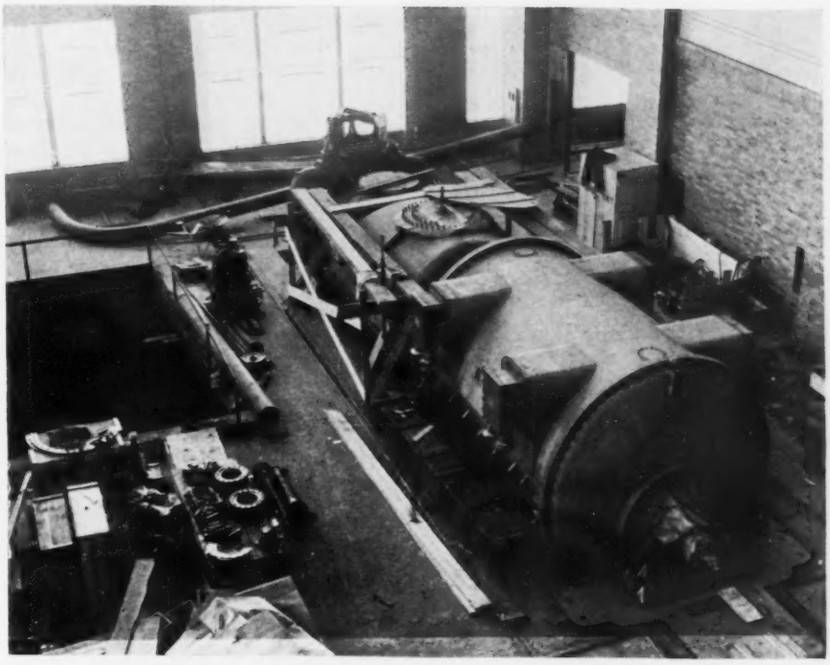
Plans $500,000 Program

A $500,000 expansion program for the municipal light plant of the Wyandotte, Mich., has been outlined to the City Council. The expansion, which will double the plant's present 6,000 kw. generating capacity, will be carried out over an eighteen-month period. It is planned to enlarge the plant building and add a new 6,000-kw. turbo-generator and steam boiler.



NEW TURBO-GENERATOR—Work is progressing rapidly on the installation of the new 35,000-kw. Westinghouse turbo-generator in the East Peoria station of Central Illinois Light Co. The plant is scheduled for operation this June

Calgary Power Proceeding With Project Construction

To meet a special demand for power for war purposes, Calgary Power Co., Ltd., by arrangement with the Dominion Government, has contracted for machinery and is in process of constructing a power and storage project at the outlet of Lake Minnewanka near Banff, according to the annual report to stockholders.

The undertaking will require the authority of Parliament and the work has been proceeded with on the assurance that the necessary confirmatory legislation would be introduced in Parliament by the government. It is estimated that the cost of this development, including additions to transmission facilities and other improvements, will amount to approximately $3,000,000.

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MKB Prize Contest

More interest was taken in the water heater prize contest of the Modern Kitchen Bureau this year than in any previous year. Twenty-five companies said they would try to make an entry, twelve got under the barrier for a shot at the $500, $300 and $200 prizes. Those entering included Ohio Public Service, Wisconsin Electric Power, Jersey Central Power & Light, Washington Water Power, Knoxville Electric Power & Water, Dayton Power & Light, Florida Power & Light, El Paso Electric, Idaho Power, Portland General Electric, Puget Sound Power & Light and Wisconsin Public Service, Green Bay.

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New Santee-Cooper Lines to Cost $420,000

South Carolina Public Service Authority, Charleston, has received low bids from the H. B. Nelson Construction Co., Atlanta, Ga., for two transmission lines from switchyard at Pinopolis hydro-electric generating station, near Moncks Corners, S. C., to Bowman and North Charleston, respectively. The first noted will be 45 miles long, with bid tendered at $258,356; the line to North Charleston will be 30 miles long, with low bid of $161,707 for construction. Awards are scheduled to be made soon. The Harza Engineering Co., Charleston, is consulting engineer.

The authority has awarded a contract to the Elliott Construction Co., Omaha, Neb., at $344,155 for construction of main switchyard at hydro-electric power plant noted, and miscellaneous work in connection therewith.

An allotment of an additional $522,000 loan and $203,000 grant for Santee-Cooper hydro-electric project in South Carolina has been approved by President Roosevelt. The South Carolina Public Service Authority will use the funds to purchase and rehabilitate properties of the South Carolina Utilities Co. in Horry County.

Program is Prepared for E.E.I. Convention

A program in keeping with the time and as "dynamic as the world events that are influencing the life and business of every American" is nearing completion for the annual convention of the Edison Electric Institute, to be held June 2-5 in Buffalo.

The Institute stated that the activities of the electric light and power industry will receive a new and intensive examination at the convention, with full regard for the increasingly important task the industry is performing as its part in the national defense effort.

It was stated that the delegates will have an exceptional opportunity to become better acquainted with the national and international situation in general through authoritative addresses by men who are filling key assignments in the co-ordination of business and government defense activities. The addresses are expected to give the industry's executives a clearer vision of what will be expected of their companies in serving the expanding production and should be helpful as background in the laying out of possible expansion plans along a sound course.

•

Power Capacity Seen Adequate for Demand

Paying tribute to the wholehearted co-operation of the private electric utilities in efforts to assure ample power for defense needs, Leland Olds, FPC chairman, speaking at Manhattan College, New York, last week, said that capacity provisions were adequate to the demands of this year and next. His remarks were taken by members of the audience to indicate that previously expressed fears of power shortage in 1942 were now to be considered as unfounded and that there was no danger, not before 1943, of power insufficiency hampering defense production.

In equally amicable words of appreciation of the work of FPC, John C. Parker, vice-president of the Consolidated Edison Co. of New York, who spoke later on the same program, told how the utilities have always studied and planned to anticipate load growth as a normal part of their operations. He said that the present condition must be regarded not as something new, but as an acceleration of tempo in an established practice and that he was confident that the utilities would be ready to serve the defense load as fast as it grew.

Indicating the measure of appreciation of their responsibility by the electric utilities, Mr. Parker cited orders placed for 3,100,000 kw. of new capacity since June 1 last year.

Gerald V. Cruise, New York State Power Authority, following Mr. Olds on the platform, described the engineering aspects of the proposed St. Lawrence project so far as they have been developed.

•

Grants Hydro License

The Federal Power Commission has authorized the issuance of a major license for a period of 50 years to Pacific Gas & Electric Co. and Sacramento Valley Utility Co., as joint licensees for construction, operation and maintenance of a hydro-electric power plant of 12,500 hp. capacity on the Yuba River, near the U. S. Government Upper Narrows Debris Dam in California.

•

Approves Generating Unit

Wisconsin Public Service Commission has approved the final plans and estimates of the municipal utility of the city of Fennimore for the installation of a Diesel generating unit at an approximate cost of $85,000.

U. S. Leads World in Water Power Units

The United States led the world at the end of 1940 in the horsepower capacity of waterwheels in water power plants, according to the Geological Survey of the Department of Interior. With an installed capacity of 19,000,000 hp. in waterwheels, the United States had more than twice as much waterwheel power as Canada, in second place.

Canada was rated as having 8,584,000 hp., with Italy in third place with 6,250,000 hp.

The total capacity of waterwheels in power plants throughout the world was 69,400,000 hp. at the end of 1940, against 23,000,000 hp. at the end of 1920.

•

Seeks Account Transfer

Pennsylvania Power Co., New Castle, has filed a petition with the Federal Power Commission for permission to transfer an amount of $105,122 included in Account 107, Electric Plant Adjustments, to Account 146, Other Deferred Debits, and to proceed with a plan of amortization authorized by the state Public Utilities Commission.

COMING MEETINGS

Edison Electric Institute—Engineering committees, Edgewater Beach Hotel, Chicago, Ill., May 5-8. Annual convention, Buffalo, N. Y., June 2-5. Major H. S. Bennion, managing director, 420 Lexington Av., New York, N. Y.

National Metal Trades Association—Annual convention, Palmer House, Chicago, Ill., May 8-9. Harry S. Flynn, secretary, 60 E. 42d St., New York, N. Y.

Air Conditioning and Refrigerating Machinery Association—Annual meeting, The Homestead, Hot Springs, Va., May 8-10. William B. Henderson, executive vice-president, Southern Bldg., Washington, D. C.

Illuminating Engineering Society — Northeastern Regional Conference, Hartford, Conn., May 9-10. F. G. Horton, executive secretary, 51 Madison Avenue, New York, N. Y.

National Electrical Manufacturers Association—Spring meeting, The Homestead, Hot Springs, Va., May 11-15. W. J. Donald, managing director, 155 East 44th St., New York, N. Y.

National Fire Protection Association — Annual meeting, Royal York Hotel, Toronto, Canada, May 12-17. Robert S. Moulton, technical secretary, 60 Batterymarch St., Boston, Mass.

Northwest Electric Light and Power Association—Annual meeting, accounting and business practice section, Baker Hotel, Baker, Ore., May 15-16. Berkeley Snow, executive secretary, 707 Spalding Bldg., Portland, Ore.

National Electrical Wholesalers Association—Annual convention, The Homestead, Hot Springs, Va., May 18-22. E. Donald Tolles, managing director, 165 Broadway, New York, N. Y.

Pacific Coast Electrical Association—Annual convention, Hotel del Coronado, Coronado, Calif., May 21-24.

Missouri Valley Electric Association—Spring accounting conference, Continental Hotel, Kansas City, Mo., May 22-23. I. D. Pettegrew, director, 1527 Sharp Bldg., Lincoln, Neb.

Empire State Gas and Electric Association—Electric operating group, Van Curler Hotel, Schenectady, N. Y., May 23. George H. Smith, secretary, Grand Central Terminal, New York, N. Y.

Public Utilities Advertising Association — Annual convention, Hotel Statler, Boston, Mass., May 26-27. James Macdonald, chairman, Boston Edison Co., Boston.

National Association of Purchasing Agents—Annual convention, Chicago, Ill., May 26-29. G. A. Renard, executive secetary-treasurer, 11 Park Place, New York, N. Y.

American Society of Heating and Ventilating Engineers — Semi-annual meeting, Palace Hotel, San Francisco, Calif., June 16-19. A. V. Hutchinson, secretary, 51 Madison Av., New York, N. Y.

American Institute of Electrical Engineers—Summer meeting, Royal York Hotel, Toronto, Canada, June 16-20. H. H. Henline, national secretary, 29 West 39 St., New York, N. Y.

Pacific Heating and Air Conditioning Exposition—Exposition Auditorium, San Francisco, Calif., June 16-20. Publicity Department, Pacific Heating & Air Conditioning Exposition, Grand Central Palace, New York, N. Y.

American Society of Mechanical Engineers—Semi-annual meeting, Kansas City, Mo., June 16-20. C. E. Davies, national secretary, 29 West 39th St., New York, N. Y.

American Society for Testing Materials — Annual meeting, Palmer House, Chicago, Ill., June 23-27. R. E. Hess, assistant secretary, 260 South Broad St., Philadelphia, Pa.

Canadian Electrical Association — Annual meeting, Seigniory Club, P. Q., Canada, June 25-27. B. C. Fairchild, secretary, 804 Tramways Bldg., Montreal.

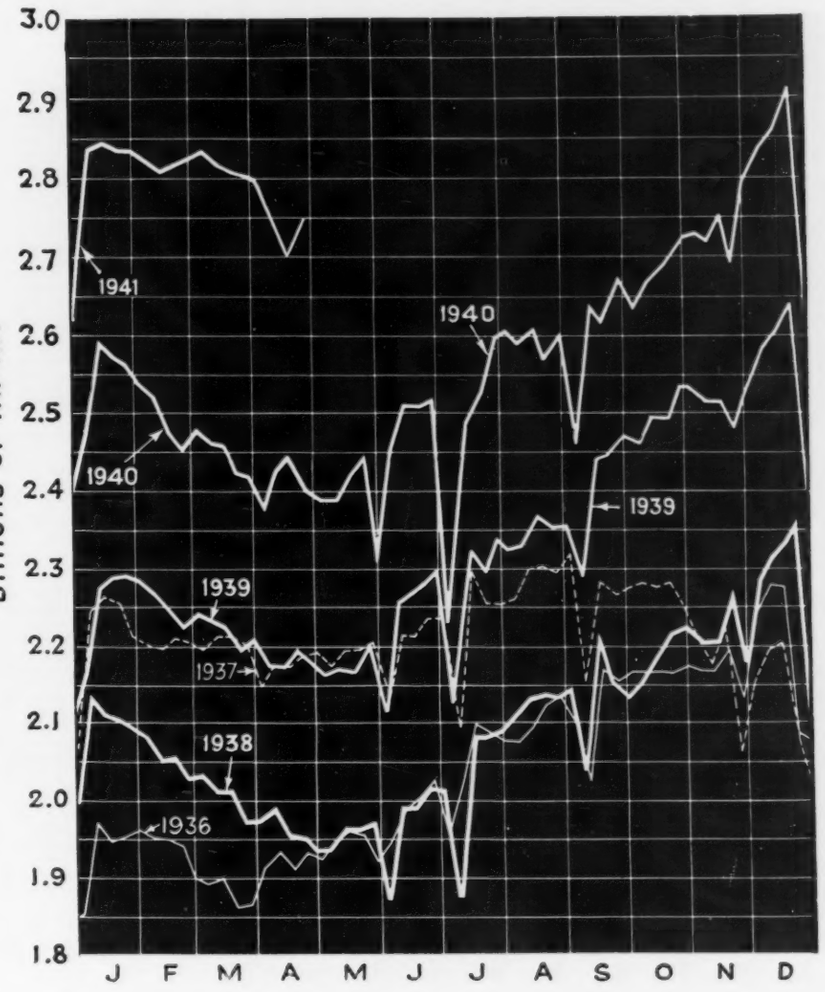
Energy Output Rises Sharply During Week

Energy production by the electric light and power industry for the week ended April 26 rebounded sharply from the decline of the two preceding weeks to regain more than half of the loss. The Edison Electric Institute reports total production of 2,750,277,000 kw.-hr., a gain of 14.7 per cent over the same week last year.

There was a gain in all geographic regions, sharply pronounced in the New England, Middle Atlantic and central industrial states, where large scale defense production is in full force.

Last year power output showed a drop during the last week of April, whereas this year the reverse was true. Indications are that variations will continue for some time, but no change in the basic trend is anticipated. The high rate of output continues with only short interruptions.

The change to daylight saving time is expected to decrease somewhat the lighting load from now until fall. However, the large volume of electrical appliance sales is expected to add new residential load.



Weekly Output, Millions Kw.-Hr.

1941		1940		1939	
Apr. 26	2,750	Apr. 27	2,397	Apr. 29	2,182
Apr. 19	2,701	Apr. 20	2,421	Apr. 22	2,199
Apr. 12	2,721	Apr. 13	2,418	Apr. 15	2,171
Apr. 5	2,778	Apr. 6	2,381	Apr. 8	2,173
Mar. 29	2,802	Mar. 30	2,422	Apr. 1	2,210
Mar. 22	2,809	Mar. 23	2,424	Mar. 25	2,198
Mar. 15	2,817	Mar. 16	2,460	Mar. 18	2,225
Mar. 8	2,835	Mar. 9	2,464	Mar. 11	2,238
Mar. 1	2,825	Mar. 2	2,479	Mar. 4	2,244
Feb. 22	2,820	Feb. 24	2,455	Feb. 25	2,226

Per Cent Change from Previous Week

	Week Ending		
	Apr. 26	Apr. 19	Apr. 12
New England	+20.5	+17.6	+14.6
Middle Atlantic	+11.0	+ 5.4	+ 9.3
Central Industrial	+20.2	+16.7	+16.4
West Central	+13.7	+12.4	+14.7
Southern States	+15.3	+12.9	+13.3
Rocky Mountain	+14.1	+14.0	+10.2
Pacific Coast	+ 4.7	+ 4.4	+ 8.1
Total United States	+14.7	+11.6	+12.5

Pittsburgh Blackout

Last week Pittsburgh experienced a wartime scene when the steel center had its first blackout, which started at 10:10 p.m., while seven planes, simulating enemy bombers, flew over the city. Duquesne Light shut off most of the street lights, sirens were sounded by fire engines and motor vehicles pulled to the side of the road with dimmed lights and horns blowing. All display lights were darkened in residential and business districts. It was a five-minute blackout and all went well.

•

Authorizes New Line

Eastern Shore Public Service Co. of Virginia has received permission from the State Corporation Commission to obtain $125,000 from the Eastern Shore Public Service Co. of Delaware for construction of a transmission line from the Maryland-Virginia state line to Tasley, Va. The commission stipulated that no dividends should be paid on the capital stock of the Virginia company out of the $125,000.

•

Plan New Hydro Plant

Wisconsin Hydro-Electric Co. is to construct a 1,250-kw. generating station near its load center at Clear Lake, according to R. M. Houger, president. The state commission has approved the project, which will cost approximately $185,000 and be completed before next winter.

•

Starts Plant Addition

Central Ohio Light & Power Co. has started construction on an addition to its generating station at Bluffton. The $1,000,000 addition will house a 7,500-kw. turbo-generator unit. Present capacity is 10,000 kw.

Confirm Board Appointees

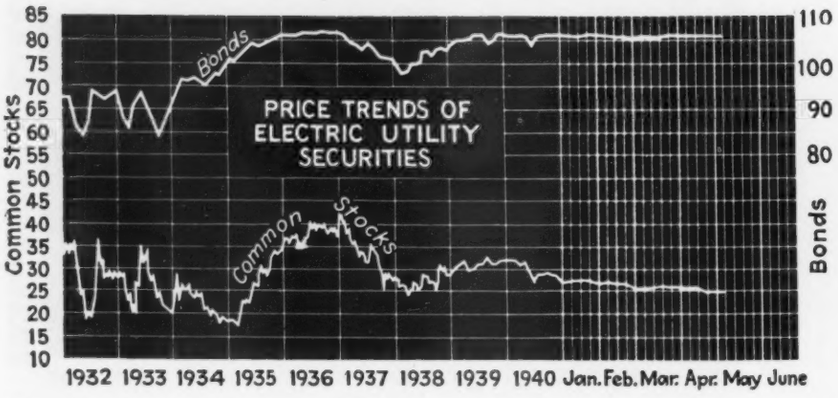
Governor Broughton's two appointments to the North Carolina Utilities Commission, Fred C. Hunter, Charlotte lawyer, and Prof. Harry Tucker, a professor at State College, have been confirmed by the State Senate. Mr. Hunter will serve for two years and Professor Tucker for four years, with Stanley Winborne, elected by the people two years ago, to serve for six years as chairman.

•

Authorizes New Lines

Certificates authorizing construction and operation of 143 miles of rural electric line were issued recently by the Illinois Commerce Commission to three public utility companies. Of this total mileage, Central Illinois Electric & Gas Co. will build 42 miles, Central Illinois Light 86 miles and Public Service Co. of Northern Illinois 14 miles.

Securities Move in Narrow Range


PRICE TRENDS OF ELECTRIC UTILITY SECURITIES
Bonds
Common Stocks
Common Stocks
Bonds
85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10
110 100 90 80
1932 1933 1934 1935 1936 1937 1938 1939 1940 Jan. Feb. Mar. Apr. May June

Electric light and power securities moved within narrow confines during the past week—Electrical World stock index advancing slightly to 24.1; last week, 24.0; last year, 31.5. Bonds turned downward—Electrical World index, 105.9; last week, 106.0; last year, 106.2

Rules on Utilities Stocks Repurchase

Public utility holding companies wishing to repurchase their own preferred stock, either by tender or in the open market, must inform their preferred-stock holders of current estimates of the stock's break-up value.

This position was taken by the Securities and Exchange Commission recently in granting permission to Engineers Public Service Co. to purchase for retirement up to 5,000 shares of its preferred stock.

Wisconsin Electric Power Co. has been granted permission by SEC to extend the maturity of three promissory notes, aggregating $4,000,000. The three notes, for $1,250,000, $1,250,000 and $1,500,000, originally were due on October 28 of the years 1941, 1942 and 1943, respectively. Each note is to be extended eight years with the interest rate increased from 2⅝ per cent to 3 per cent during the extended period.

The commission has granted the request of the city of Cincinnati to intervene in the proceedings regarding the issuance and sale by Columbia Gas & Electric Corp. of $92,000,000 of sinking fund debentures, due 1961, and $28,000,000 of serial debentures, due 1941-1951.

Commonwealth & Southern Corp. has filed a declaration regarding a proposed loan of $671,050 on open account to its subsidiary, South Carolina Power Co. The loan is to bear interest at the rate of 3½ per cent per annum.

SEC has granted the application of NY PA NJ Utilities Co. to acquire by merger all the $27,165,744 of assets and assume all the liabilities of General Utility Investors Corp., its wholly owned subsidiary.

•

Will Sell Stock of Unit

North American Co. has filed an application covering the proposed sale of 58,710 shares of 4¾ per cent series preferred stock of its subsidiary, the Wisconsin Electric Power Co. Proceeds will be used either to redeem part of the company's outstanding debentures or for other general corporate purposes.

•

Standard Gas Settles Chicago Tax Argument

Standard Gas & Electric Co., which moved its offices to New York from Chicago a little more than two years ago to escape "prohibitive" personal property taxes levied by Cook County, has compromised its differences with the taxing authorities and will return to Chicago on June 1.

Cook County authorities had levied personal property taxes for 1936 and 1937 aggregating $1,500,000. The company won a lower court decision setting this assessment aside. The county appealed and during the pendency of this action a compromise was reached under which Standard Gas would pay only $35,000 for each of the two years. An agreement has been made under which the company will keep enough cash and intangibles in Illinois to make up a tax of about $35,000 annually.

•

Will Redeem Bonds

Iowa-Nebraska Light & Power Co. has called for redemption on June 4, 1941, all of its outstanding first lien and refunding mortgage 5 per cent bonds, series A, due 1957, at 102½. The company has also called for redemption on May 5, 1941, all of its outstanding first lien and refunding mortgage 5 per cent bonds, series B, due 1961, at 102½, in each case with accrued interest.

Files Application for Issue of Notes

Wisconsin Power & Light Co. has filed a declaration with the Securities and Exchange Commission regarding the proposed issuance and sale of $1,000,000 of 2¾ per cent unsecured notes to Continental Illinois National Bank & Trust Co. of Chicago.

The notes are to mature in four semi-annual installments of $185,000 each on December 1, 1946, to and including June 1, 1948, and in one installment of $260,000 on December 1, 1948.

Proceeds are to be applied to the cost of carrying out the company's 1941 construction program, which includes the installation of an additional 30,000-kw. steam generating unit at its Edgewater station in Sheboygan, Wis., and the construction of related substation and transmission line equipment.

•

Permits Utility Merger

SEC has issued an order permitting to become effective the declaration of the Public Service Co. of Colorado, a subsidiary of Cities Service Power & Light Co., regarding the acquisition of the assets and assumption of obligations of its wholly owned subsidiary, United Hydro-Electric Co., following which the subsidiary would be dissolved.

•

SEC Makes Revisions

A general revision of rules under the Holding Company Act designed to simplify language and to eliminate provisions which are obsolete or of infrequent applications has been announced by the Securities and Exchange Commission. SEC said substantial changes have been made in the revised rules.

Utility Reports

	Net Income 1941	1940
*California Oregon Power.	$1,002,034	$907,007
†Commonwealth & Southern and subs.	13,628,834	13,699,733
*Duquesne Light	10,204,750	10,416,118
*Florida Power & Light	2,354,850	1,772,410
*Kansas Gas & Electric	1,635,870	1,201,459
*Louisville Gas & Elec. (Ky.) and subs.	2,871,217	2,866,573
*Minnesota Power & Light.	1,397,318	1,375,253
*Montana Power and subs.	3,831,215	3,454,208
*Nebraska Power	1,698,360	1,735,449
†Philadelphia Electric and subs.	22,606,802	22,369,197
†Public Service Corp. of N. J. and subs.	23,421,263	25,829,278
*Puget Sound Power & Light and subs.	2,019,553	2,139,666
‡San Diego Gas & Elec.	2,234,266	1,363,022

*Twelve months ended February 28.
†Twelve months ended March 31.
‡Twelve months ended January 31.

=1500 FEET

That's the extension you can put on a typical feeder by using G-E induction regulators to cut band width*

RECENT tests show that G-E induction regulators hold feeder voltage within a two-volt effective band or less, in contrast to band widths of 4 volts or more held by feeder voltage regulators of other types.

This advantage can be used profitably in any one of several ways, depending on feeder conditions. For example, the G-E two-volt band width will allow a 15-per-cent extension—or 1500 feet—of a typical feeder, with the same voltage difference between the first and last transformer. Or it will permit increasing the load on existing feeders. In other cases, it can be used to recover revenue lost because of feeder voltage drops.

Whatever the conditions of your feeders, you will find that the G-E induction voltage regulator pays a large extra dividend on your investment in regulation.

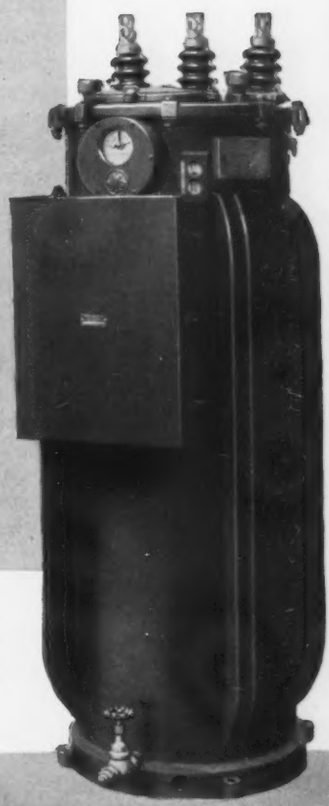
Ask your G-E representative to show you on simplified charts just how much the narrower band width held by G-E induction regulators means to you—on your own feeders—in terms of feeder length, load capacity, or reduced revenue losses. General Electric Company, Schenectady, New York.

Quick Response to Voltage Changes

One reason why G-E induction regulators hold closer voltage is that they respond immediately—without time delay—to voltage changes.

When a voltage fluctuation touches the edge of the voltage band, the induction regulator corrects voltage immediately. It does not wait until the average voltage is outside the band-width setting, as is the case when time delay is used.

If the voltage is characterized by a one-volt fluctuation, the induction regulator will hold a one-volt narrower band width for the same voltmeter band-width setting. This advantage results solely from the immediate response of the induction regulator.



* For Engineers Who Like to Do Their Own Figuring:
This typical example is based on a reduction of 2 volts in band width on a three-phase, 225-amp, 4-kv feeder of 4/0 conductor, 53-inch equivalent spacing, uniformly loaded; length, 10,000 feet; p-f, 90%.

GENERAL ELECTRIC

404-21-5400

OPERATING PRACTICES

Bus-Way Serves Plant Auxiliaries

By E. E. FAY, Jr.
Distribution Engineer
Department of Utilities, Fremont, Neb.

Reliability of power supply to vital situation auxiliaries at the power plant of the Department of Utilities, Fremont, Neb., coupled with need for a high current-carrying capacity in a small sectional area largely influenced design of the auxiliary power system that was adopted during recent reconstruction of the plant.

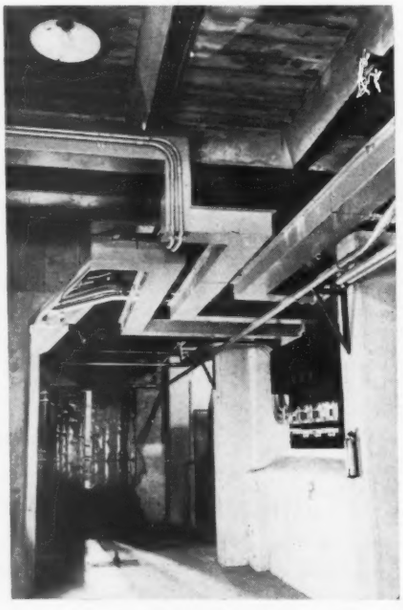
All boiler room auxiliary electric equipment, including forced and induced draft fans, stoker motors, coal larry, turbine condensate pumps and water-softening equipment, besides a traveling crane, electric elevators and a motor-generator battery charger, are supplied with power from two transformer stations through a suitable switching arrangement.

Any one or all of three low-voltage feeders may be energized from either or both transformer stations, which in turn are energized from the 2,400-volt station bus through separate oil circuit breakers, providing a very flexible operating condition. The oil circuit breakers in the low-voltage circuit are operated remotely by multi-stage rotary type control from the operating floor, while the disconnects are manually operated.

Branch circuit wiring is so arranged that the auxiliary electric equipment for each boiler or turbine is supplied by a different feeder and panelboard. In the event of trouble in one feeder, panelboard or branch circuit, a standby boiler or turbine may be placed on the line, with the necessary auxiliary electric equipment being supplied from a different feeder and panelboard.

From the 300-kva. transformer station to its secondary oil circuit breaker 1,500-amp. conductors were necessary, while 750-amp. conductors were sufficient between the 150-kva. transformer and its secondary breaker. The three feeder circuits between the switching bus and distribution panelboards required conductors with a 750-amp. capacity.

Three methods of running the large conductors between the transformer stations and switching bus and between the switching bus and distribution panelboards were studied. Rigid conduit and metal raceways with insulated conductors and metal-inclosed bus-way were considered most feasible. The numerous turns and elevations that the route required, along with the large size of conductors, the consequent difficulty involved in pulling and forming the insulated conductors and the narrow spaces through which the conductors must pass eliminated the conduit and raceways. Beyond the distribution panelboards, which were the multi-breaker type, no problem was involved as the conductors were smaller and rigid conduit served perfectly.



HIGH current-carrying capacity in small sectional area and ability to turn 90-deg. bends in constricted space influenced use of bus-way construction

Metal bus-way was selected and installed because it provided high current capacity in a small cross-sectional area, because of its ability to make 90-deg. turns either vertical or horizontal, along a constricted route. Mechanical protection of the conductors is entirely adequate, taps are easily made and the complete installation presents an excellent appearance.

During the recent reconstruction of the plant it was necessary to maintain full plant operation at all times. Work had to be completed in sections. Bus-way worked very nicely with this program. As a section was completed, temporary feeders were easily connected to the end of the bus-way at any stage of the construction.

•

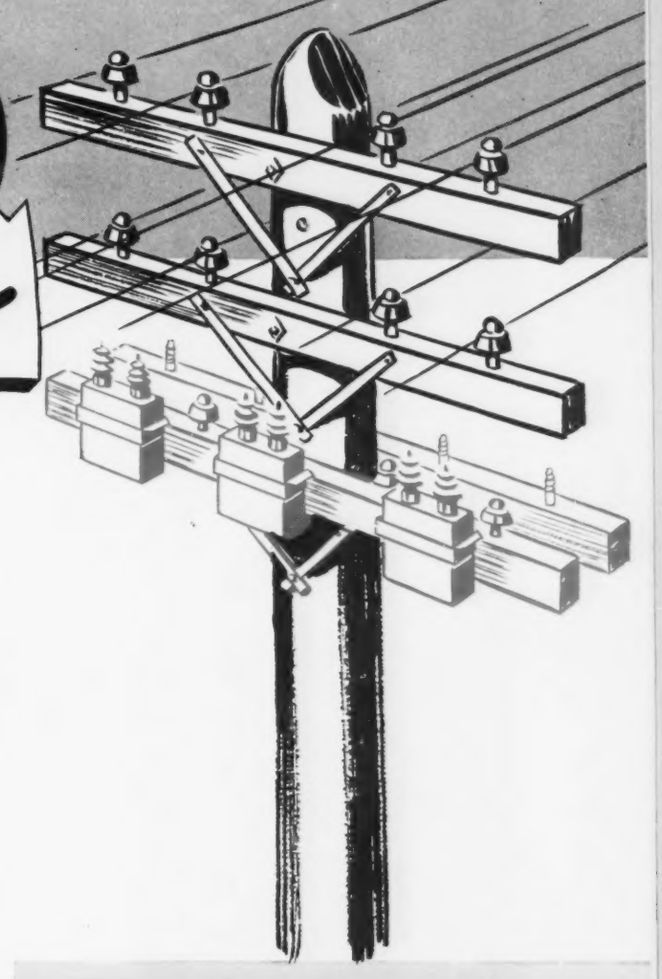
Unit Substation for Indoor Service

By NORMAN G. ZAUTNER
Switchgear Division,
Philadelphia Works, General Electric Company

An indoor unit substation recently installed at the Alexandria generating station of the Virginia Public Service Company offers possibilities for application also in industrial plants, office and public buildings.

The switchgear controls station auxiliary feeders and has a throat

Add System Capacity at Low Cost



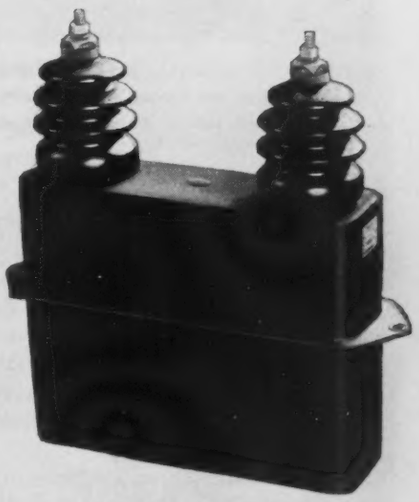
PYRANOL CAPACITORS RELEASE GENERATOR, SUBSTATION, AND FEEDER CAPACITY TO MEET NEW LOAD DEMANDS

YOU get them right from our warehouses; and installing them is only a matter of days. That's why Pyranol capacitors for power-factor improvement are the *quick, low-cost way to gain kw capacity.*

Moreover, they not only boost the loadability of the low-power-factor lines where they're installed, but they reflect this improvement clear back to the generators.

They're easy to move to new, more effective locations, too. And that's a very important factor when you're trying to keep up with today's fast-growing, fast-shifting loads.

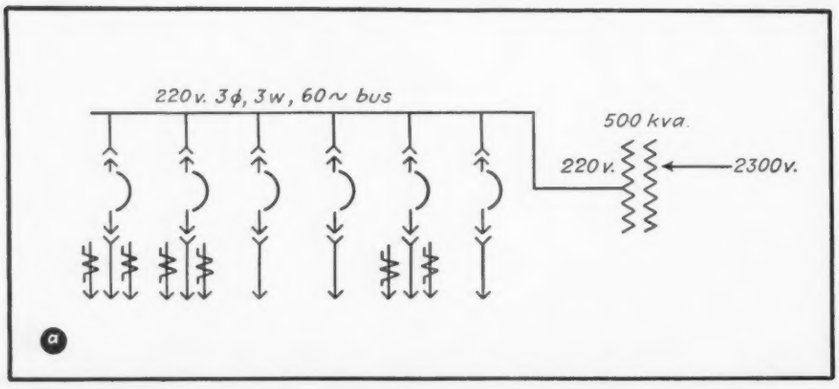
Call your G-E representative *now* for an estimate of the increase possible in your system capacity by means of Pyranol Capacitors. General Electric, Schenectady, N.Y.

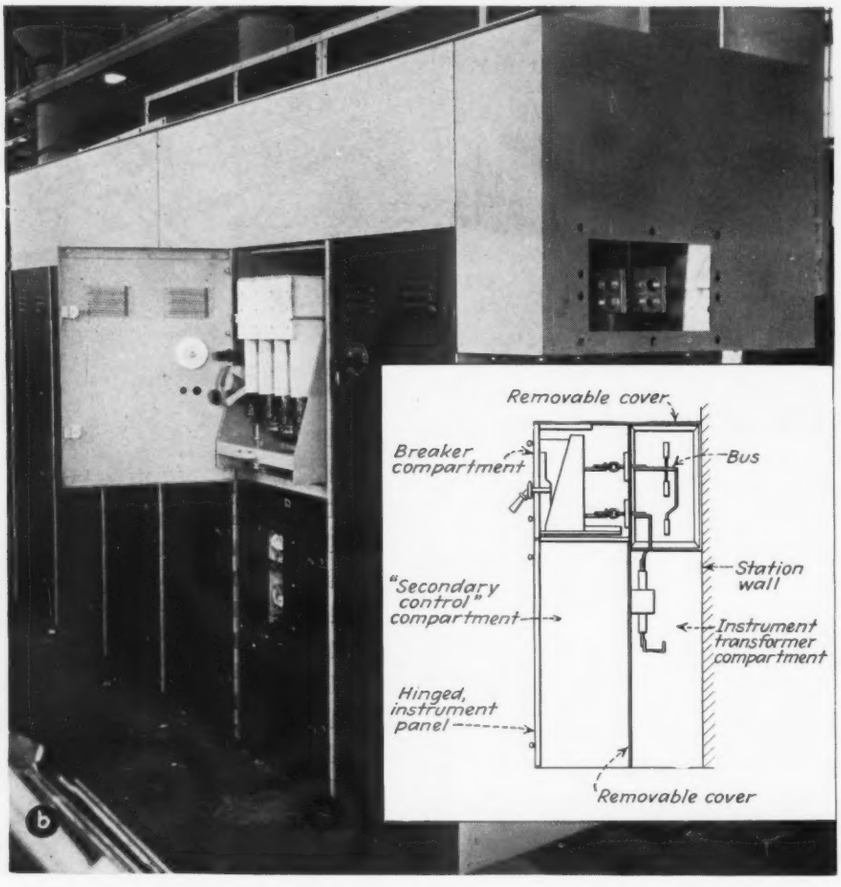


Described in Bulletin GEA-3333

GENERAL ELECTRIC

407-20-5700





INDOOR unit substation proves as practical as an outdoor type. Drawout-type air circuit breakers are arranged in separate compartments at front top of units, with space for meters and relays on lower compartment door

connection from a 500-kva., 2,300/220-volt transformer. The unit was designed for back-to-wall installation. Depth is reduced to a minimum, thus permitting fuller use of the available floor space. Another feature permits connection leads to enter from above through pull boxes on top of the structure, or from below, if that is desired.

There is only one circuit per unit, with a conventional-type drawout air circuit breaker in a separate compartment at the front top of the unit. The bus is located in the upper rear compartment; access to it is provided by removable top covers. Space in the lower compartment accommodates secondary control equipment and instrument transformers.

Hinged doors in front of the air circuit breaker and secondary control compartments give complete accessibility to all parts and provide a neat appearance for the front of the board as well. A removable plate permits access to the instrument transformers so that cable connections can be made from the front of the equipment. Space for meters and relays is provided on the lower compartment door.

The equipment was factory-built and shipped assembled. A. P. Campbell and A. H. Phillips of the E. M. Gilbert Engineering Corporation collaborated with engineers of the General Electric switchgear division in design and installation.

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Hints on Selection, Use of Reactors—II

By L. E. SAUER

Westinghouse Electric & Manufacturing Company, Sharon, Pa.

Mechanical properties have second place* in the selection of current-limiting reactors. Since these reactors are rarely called upon to stand sustained short circuit, it is very seldom that mechanical failure is so complete in one short circuit that electrical failure will also take place.

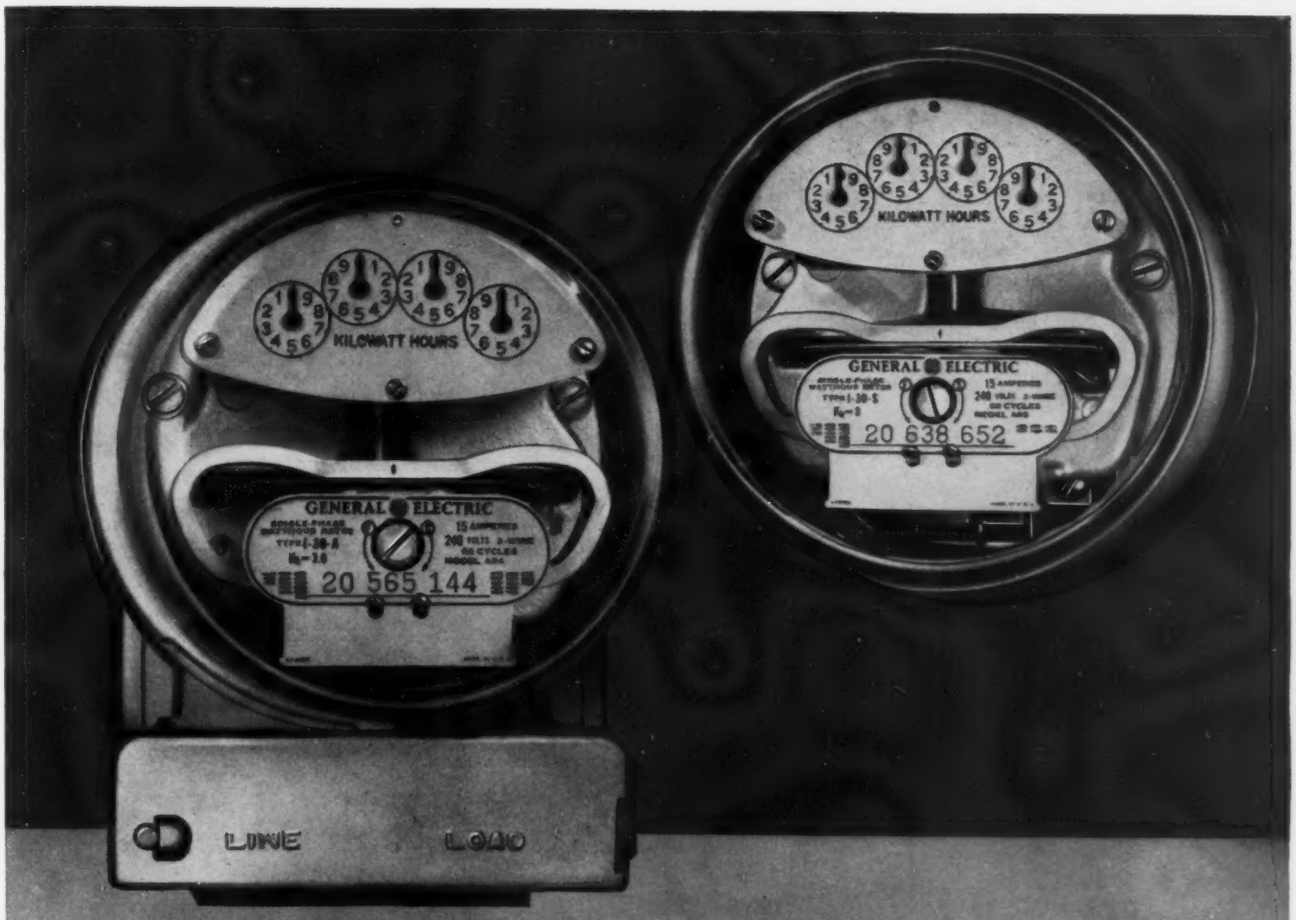
Cables should be supported by materials that have good compressive strength. There should be a sufficient number of these supports to prevent deformation of the cable by short-circuit stresses. Too great a span of unsupported cable is probably the chief cause of mechanical failures.

Current-limiting reactors should be capable of withstanding the force due to an instantaneous asymmetrical current of 2.4 times the sustained r.m.s. short-circuit amperes. Considerable design data are necessary to make an exact comparison of the strength of unsupported cable spans. An approximate comparison, however, can be made between designs of the same rating if the cable cross-section is known. The cable span may be considered to vary directly with the three-fourths power of the cross-sectional size. Size of cable strands does not affect cable strength as used in reactor construction.

Other mechanical difficulties arise from incorrect spacing of reactors and the way leads are connected to them. To minimize the forces between reactors it is best to install single-phase coils in separate cells. Next best is to place single-phase reactors in the same cell with insulating barriers between them.

If at all possible, reactors should be separated sufficiently to avoid the need for bracing insulators, as brac-

*A previous article ("Electrical World," April 19, 1941, p. 78) discussed electrical properties.



WHY TEMPERATURE-COMPENSATED MAGNETS?

(CLASS I TEMPERATURE COMPENSATION)

There are many physical and electrical characteristics of watthour meters that are sensitive to changes in temperature. The damping strength of the permanent magnet is one of the most important of these characteristics, for unless the magnet is compensated for temperature changes, variation in its strength will adversely affect the meter's performance.

Protection against the effect of temperature changes upon the permanent magnet is obtained by placing a temperature-sensitive alloy between the magnet poles so that it by-passes a small amount of the damping flux. The characteristic of this alloy is such that when a decrease in temperature would normally cause the meter to run slowly, more flux is by-passed and the speed of the meter remains constant. Conversely, the alloy by-passes less flux when an increase in temperature would otherwise cause the meter to run fast.

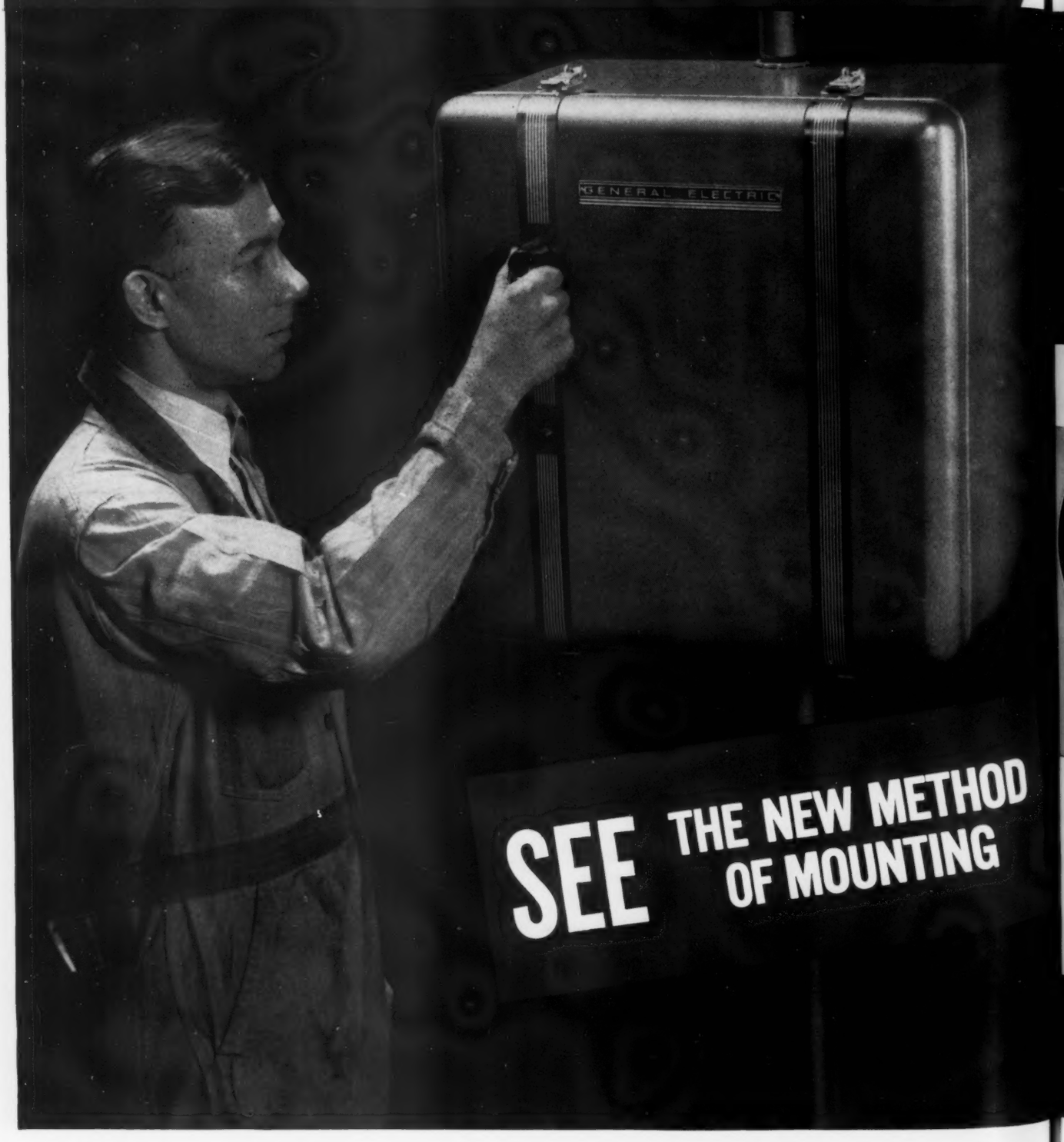
This development, known as Class I temperature compensation, was introduced by G.E. It is a fundamental feature of our I-30 line of watthour meters. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

001-7-6110

Another G-E Switchgear Feature

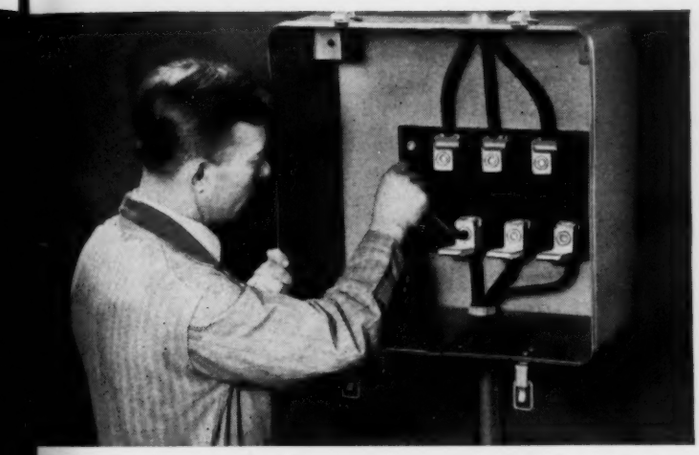
...AT NO EXTRA COST



SEE THE NEW METHOD OF MOUNTING

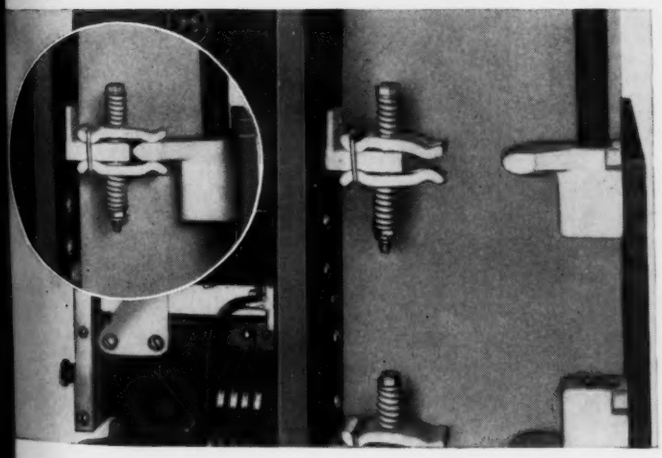
A Removable Air Circuit Breaker

So Easy to Install...So Easy to Inspect



1 Bolt case to wall and connect cables to solderless connectors.

2 Place breaker unit on brackets in enclosing case.



3 Breaker pivots into connected position automatically when pushed into place. Spring contacts engage solid contacts.

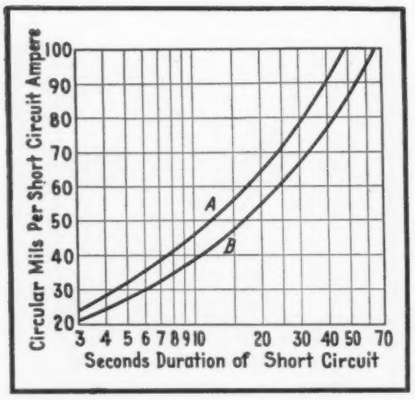
4 Bolt breaker base in place. Put on cover and handle. Breaker is ready to operate.

Take a good look at this air circuit breaker. Note the convenient, attractive new case which completely encloses the breaker unit, making it dustproof. See how the ingenious new mounting features simplify installation and inspection.

A new pictorial booklet that gives all the facts is just off the press. It shows how this enclosed breaker meets your needs for safe and reliable service on low-voltage circuits. Call the G-E office or distributor nearest you and ask for a copy of GEA-3600 or, if you prefer, address General Electric Company, Schenectady, New York.

GENERAL ELECTRIC

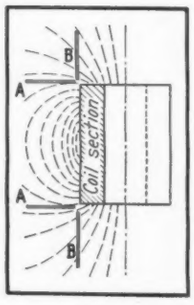
860-12-7500



SHORT-CIRCUIT current densities have these values.

Curves indicate temperature change produced by short circuit: (A) initial temperature 105 deg. C., final 250 deg. C.; (B) initial temperature 125 deg. C., final 350 deg. C. From this chart can be found the minimum cross-section of conductor for different short-circuit durations, exclusive of conductor stray losses, to meet the standards of the American Institute of Electrical Engineers.

MAGNETIC FIELD about a current-limiting reactor has this shape. Mechanical stresses in the leads can be held to very low values if the lead follows the flux lines, as shown by "A", instead of crossing them, as shown by "B"



ing increases the natural frequency of vibration which usually causes it to approach resonance with the electrical frequency, increasing the mechanical force between units. Where bracing is used between three-phase groups the middle unit should be wound or connected in reverse order to the end ones. This causes the major force, which is from two to three times the minor force, to be compressive and reduces the thrust against the cell partitions. Wherever bracing is used between units it is desirable to employ it in such a manner as to avoid tension in insulators. Porcelain and other materials used in reactor construction are much stronger in compression than in tensions.

In order to relieve the connecting leads and reactor terminals of undue stress it is advisable to provide short, flexible connections between the leads and the reactor. Structural members which form short-circuited loops, linked by the reactor flux, also may be the cause of considerable force increase on a reactor installation. If such loops are no closer to the reactor than one coil diameter no trouble should be experienced.

Thermal properties have been left until last in this discussion because they initiate failures only through the changes they effect in electrical or mechanical properties. If the limits established by American Institute of Electrical Engineers standards are adhered to and the short-circuit temperatures calculated on the basis of all heat stored in the copper according to the formulas recommended therein the electrical and mechanical properties will not be endangered.

Conductor cross-section is not a reliable indicator of normal hot-spot temperature rise. Things that make for lower hot-spot temperatures are larger diameter of coil, smaller radial depth of winding, greater spacing between conductors, several conductors in parallel rather than one large conductor, and cable supports that are smaller toward the inside of the coil than the outside.

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Dayton Analyzes Emergency Radio Uses

Analysis of the short-wave emergency radio transmissions to line crews of the Dayton Power & Light Company in the six months from July 1 to December 31, 1940, showed that of the 313 messages sent out the largest number—37 per cent—reported fires, 22 per cent concerned emergency switching operations and 12.4 per cent reported wires down. The complete breakdown follows:

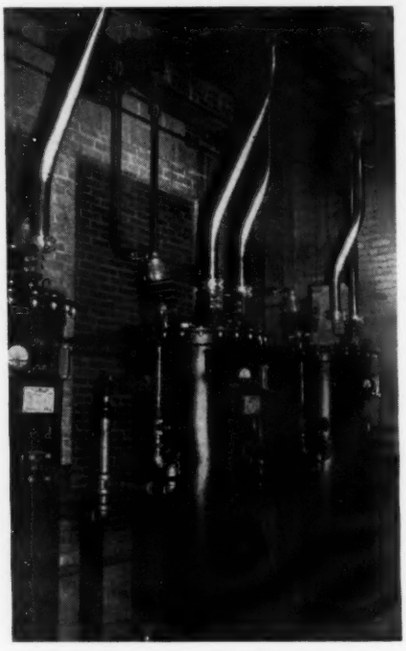
Fires	117
Wires down	39
Neighborhoods and vicinities out	10
Wire burning	8
Requests for help	14
Dispatch assistance	5
Poles broken and down	15
Transmission lines down	10
Emergency switching	69
Substation outages	2
Defective transformers	3
Gas leaks and explosions	8
Factories and Hospitals out	6
Traffic and Railroad Signals	3
Street light circuits	4
Total	313

The tabulation does not include a considerable number of transmissions wherein crews in the field were requested to call headquarters on matters of a semi-emergency nature wherein normal telephone facilities would have been used if available.

Compact, Economical Transformer Layout

At the Bucksport steam plant of the Central Maine Power Company it was necessary to locate three 333-kva., 6,900-460-volt G. E. transformers for station service inside the building rather than outdoors. A compact installation was provided by placing the bank directly below the primary and secondary buses.

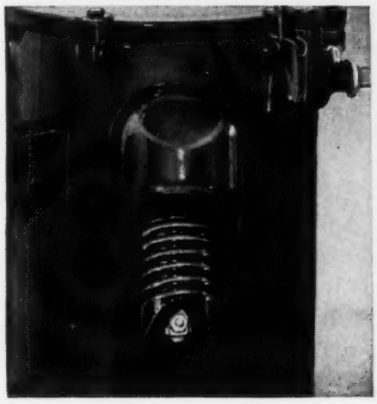
Water-cooled units were specified, as there are a number of other transformers, also water-cooled, in the same room, so located that it was not economical to furnish sufficient ventilation for self-cooled equipment. Pyranol-filled units were employed for fire protection, and the water-cooling system is arranged so that the warmed water is later used in steam production. Accessibility features all valves.



WATER-COOLED, Pyranol-filled units provide station service

The primary buses are of ¾-in. diameter tubing and the secondary buses of 2.5-in. tubing. The former are supported by 15-kv. G.E. insulators and the latter by Johns-Manville ebony asbestos fabricated on the job. A feature of the design is liberal spacing between live conductors for both voltages, provision for case drainage and mounting of transformer bases above the floor level to prevent spreading of liquid if released from casings.

ALLIS-CHALMERS DISTRIBUTION TRANSFORMER

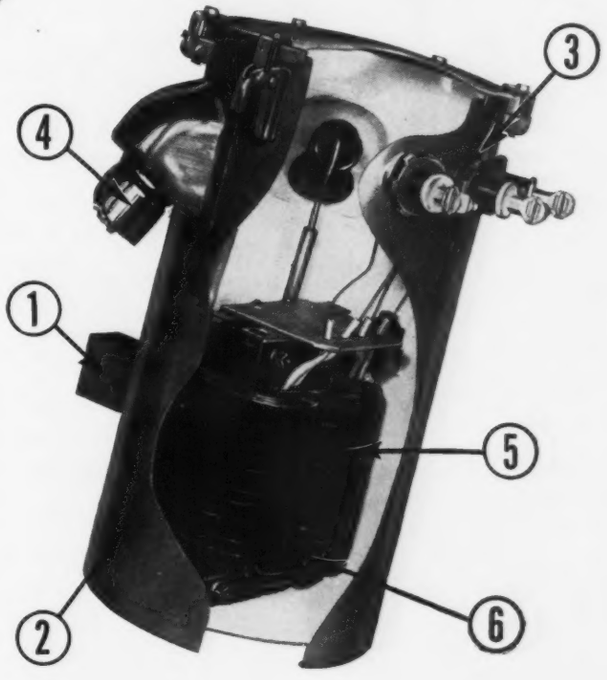


4 Extra-heavy Porcelain Coordinated Bushings with Liberal Creepage Offer Maximum Reliability Under Fog, Dust, Chemical or Other Adverse Conditions.

5 Double Conductor Insulation... Flexible Enameled Wire... Plus the Added Protection of Well-Lapped Cable Paper Provide Double Safety Against Winding Failures.

6 Improved Core and Coils, Liberally Designed with No Manufacturing Short Cuts . . . Mean Extra Years of Service-free Performance Under All Types of Operating Demands.

Engineering Features!"



that will undoubtedly save thousands of dollars, not only in first cost, but in operating expenses as well.

How is this done? By standardizing the location of supports and bushings, all sizes and makes are now completely interchangeable. This means you can get faster deliveries . . . easier installation. It also means fewer parts and fewer complete units for you to handle in stock.

Remember, too, Allis-Chalmers cuts no corners in its manufacturing process. Advanced engineering . . . plus the best material and skilled workmanship . . . give you built-in quality second to none.

For complete engineering information on the new Allis-Chalmers EEI-NEMA Distribution Transformer, call the district office near you. Or write for your copy of our new Bulletin B-6159. Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin.

A-1382

TRANSFORMERS *Cut Operating Costs*

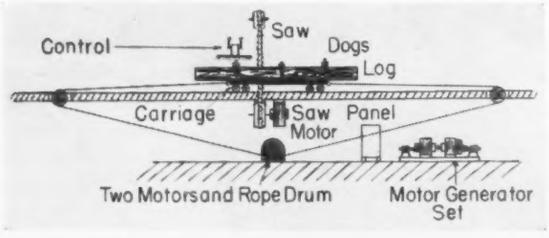
INDUSTRIAL ENGINEERING

Adapt Electric Drive to Sawmill Carriage

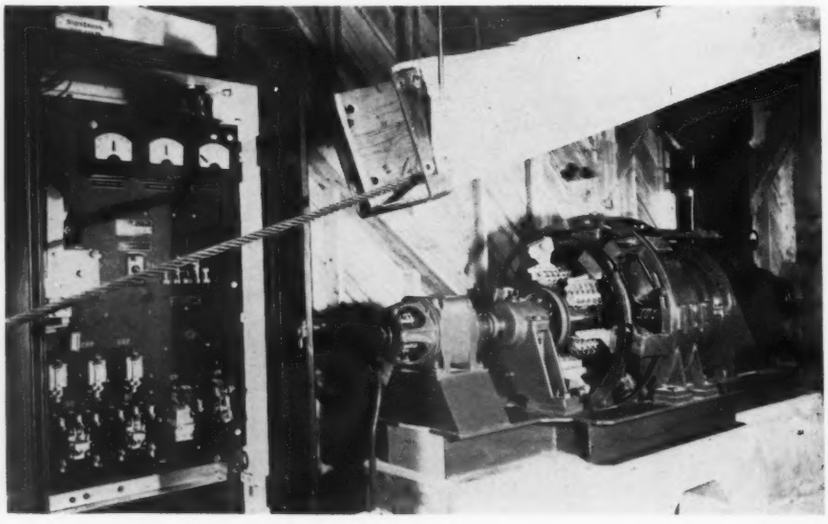
Requirements of high acceleration and retardation for a sawmill carriage drive were met with the application of amplidyne excitation, which also regulates the top speed set by the operator at the plant of the Homestake Mining Company, Spearfish, S. D.

To the ends of the conventional-type carriage are attached ⅞-in. diameter steel haulage ropes which pass over sheave wheels and are attached to the ends of a drum located between two 80-hp. General Electric motors in such fashion that one rope winds on the drum while the other winds off. These two motors speed the carriage forward through the headsaw at 600 ft. per minute and snap it back at 800 ft. per minute. Acceleration of the 27,600 WR^2 involved reaches 10.5 ft. per second. A 125-kw. induction motor-generator set with amplidyne excitation furnishes power under adjustable-voltage control. Electrically tripped emergency brakes connected to the shafts of the motors will stop the carriage within 6 ft., even at top speed.

The stored energy in the carriage is returned to the system by regenerative braking, thus the power consumed is only that required to supply the losses. In addition, the regenerative action produces a cushioning action at each end of travel.



ELECTRIC log-carriage drive speeds 16-ft. logs back and forth through headsaw in less than six seconds, making more than ten cuts per minute. Amplidyne excitation is used for 126-kw. motor-generator set (bottom)



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Cathodic Protection for Oil-Pipe Lines

By H. E. DRALLE
Manager Petroleum and Chemical Engineering Section, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Cathodic protection of pipe lines is receiving increased attention from the petroleum industry, which has found weatherproof rectifiers of the type illustrated compact, efficient and reliable units for supplying the necessary d.c. from the existing single- or three-phase supply.

The illustrated unit operates on single-phase. It is equipped with transformer, fan, a.c. incoming line contactor, voltage changing tap switch, d.c. meters, control switch and terminal board for the d.c. leads. Maximum continuous rating of this unit is 20 volts, 100 amp., although the particular application requires only 15 volts, 90 amp. The d.c. output may be varied in ½-volt increments to fit the application.

A.c. supply voltage is stepped down for use on the rectifier to 110 or 220 volts by means of a dry-type, multi-tap transformer located in the cabinet immediately behind the tap switch in the upper right-hand corner of the cabinet.

To increase the unit rating for a given space, rectifiers are usually fan-cooled when the application requires over 500 watts d.c., smaller units being self-cooled. An a.c. motor-operated fan, with blades rotating in the horizontal plane, is mounted behind the meter panel and draws incoming cooling air over the rectifier plates and discharges it at the top of the

Here's why L-M HEAVY-DUTY LIGHTNING ARRESTERS ARE PROTECTING MORE LINES THAN EVER BEFORE

1 HIGH SURGE CAPACITY

The special L-M valve composition will handle high-amperage and long-tail surges equally well.

2 LOW IMPEDANCE

Due to its characteristics, the L-M valve material holds internal resistance (IZ drop) to low values at all surge currents.

3 MOISTURE-PROOFNESS

Double "elastic" sealing at top and bottom, controlled production and thorough routine tests result in highest, permanent moisture-proofness.

4 PERMANENCE OF CHARACTERISTICS

L-M valve material is chemically and electrically absolutely stable, does not change its characteristics in operation, assures same unfailing operation, after years of performance.

5 VISUAL-INSPECTION GLASS BODIES

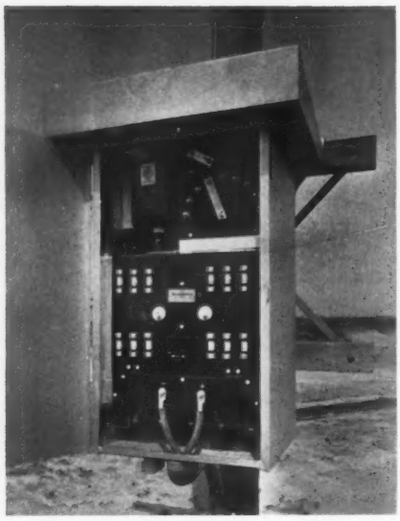
Glass bodies, exclusive with L-M Arresters (Pat. No. 2,165, 964) permit easy inspection of Arrester condition at any time without costly laboratory or field tests.

6 THE ISOLATOR FOR FEEDER-LOCK-OUT PREVENTION

Any arrester might become damaged at some time in service. The L-M ISOLATOR will then save you time and money because it will automatically cut off the faulty arrester from the line, preventing feeder lock-out or phase grounding — Only L-M Arresters have the ISOLATOR. (Pat. Pending).

Detailed information further explaining and illustrating these features and the reasons why they contribute to better service are fully covered in L-M Bulletin 40151. Write for it or ask your L-M representative for a copy.

LINE MATERIAL COMPANY



POLE-MOUNTED rectifier is fan-cooled, self-contained, bug- and weatherproof unit operating on single phase for cathodic protection of oil pipe line

unit. Transformer and line starter are in the path of the discharge air.

To insure a continuous flow of current to the pipe line, this unit, which gives full-wave rectification, is made up of a number of sections called "bridges," individually fused on both a.c. and d.c. sides. If one or more bridges are cut out by the fuses, the rectifier will continue to operate at reduced capacity.

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Raising 220-V. Factory Wiring to 440-V.—I

By EUGENE CALDWELL
Consulting Management Engineer,
Milwaukee, Wis.

More than is generally realized of the increased production required by national defense will come from the thousands of smaller industrial plants and factories that make parts, supplies, tools and specialties. In most instances these plants purchase electric power at secondary voltage, usually 220 volts. As the pressure of defense production increases many of these plants are discovering that wiring and other electrical facilities heretofore sufficient, or at least tolerable, are incapable of the duty now demanded of them. Something must be done, and usually what is done is to install more and heavier wiring. But in many cases there is an alternative more economical—and more desirable, too, in view of the enlarging defense requirements for copper. The alternative is to raise the plant distribution to 440 volts, several aspects of which will be discussed in this and following articles.

The first obvious advantage of 440 volts over 220 is that the energy capacity of the wiring is doubled. Another is the reduction of line drop losses to one-fourth. Hardly any except large industrial plants pay any attention to losses in wiring. Rarely, if ever, are these losses metered or even roughly calculated. Consequently the fact is never realized that the power used by individual motors, if added all together, does not equal the reading of the incoming meter.

Cut Line Losses

But in a plant with adequate size feeders the line losses are likely to be 2½ per cent of the total energy used. If feeders are inadequate it is easily possible that these losses approach 5 or even 10 per cent. Thus in a plant using 1,000,000 kw.-hr. per year the losses in the plant lines are likely to be 25,000 kw.-hr., estimating at 2½ per cent. With energy purchased or generated at 2 cents per kilowatt-hour, this means a loss of $500 per year. If the plant has been operating at 220 volts and the voltage is increased to 440 volts the losses will immediately be cut to 6,250 kw.-hr. per year, or a cost of $125, equaling a saving of $375 per year.

Although this saving is never large enough to justify the change to a high voltage for that reason alone, it is a worth-while saving which should be taken into consideration. It will certainly contribute that much toward defraying the cost of the changeover.

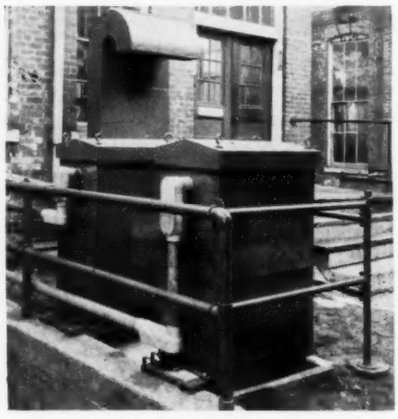
In most cases a change to higher voltage can be accomplished at lower cost than the installation of heavier feeders. Such a change is not as expensive as is usually thought. In a Midwestern plant which had been operated for many years at 220 volts there were three 500,000 cir.mil cables in 3-in. conduit down the south side of the main building and three 250,000 cir.mil cables in 2½-in. conduit down the north side. It became necessary to increase the feeder capacity in this plant because of added load over a number of years. The installation of three 1,000,000 cir.mil cables on one side and three 500,000 cir.mil on the other would have cost in excess of $10,000. The same additional capacity was secured by changing over the entire plant to 440 volts for less than $7,000.

Outdoor Capacitors Installed Sectionally

Boston Works of Allis-Chalmers recently raised their average shop power factor from about 60 per cent to 85 per cent by installing 180 kva. in Cornell-Dubilier capacitors in two rack-type outdoor units mounted on 1.5-in. x 3-in. channel-iron supports over a concrete-lined drainage pit about 5 ft. 6 in. long x 2 ft. 10 in. wide x 6 in. deep. In one metal-clad container are mounted eight 15-kva. units with four in the second container, space remaining in the latter for completing the installation to 240 kva. in case load conditions require it.

Each capacitor unit is connected in parallel to a 460-volt, three-phase factory power bus inside the nearest building, through an oil circuit breaker in each line. This enables the user to operate with 60, 120 or 180 kva. of correction according to conditions, giving a high degree of flexibility in service. The housings are grounded by ⅛-in. x 1-in. copper strap connections as shown.

The present connected power and



THREE kva. values are available from these two units

lighting load of the factory is about 400 hp. Before the capacitors were installed the demand was about 272 kva. and the billing demand 218 kw. Correction reduced this demand billing to 195 kw., saving 23 kw., or $46 per month in a typical instance. With increasing loads (the plant now consumes about 41,000 kw.-hr. per month), there is a saving of from $50 to $60 per month by the use of this equipment in connection with purchased power from Boston Edison. The installation should pay for itself in 12 to 18 months.

NEW ENGINEERING IDEAS

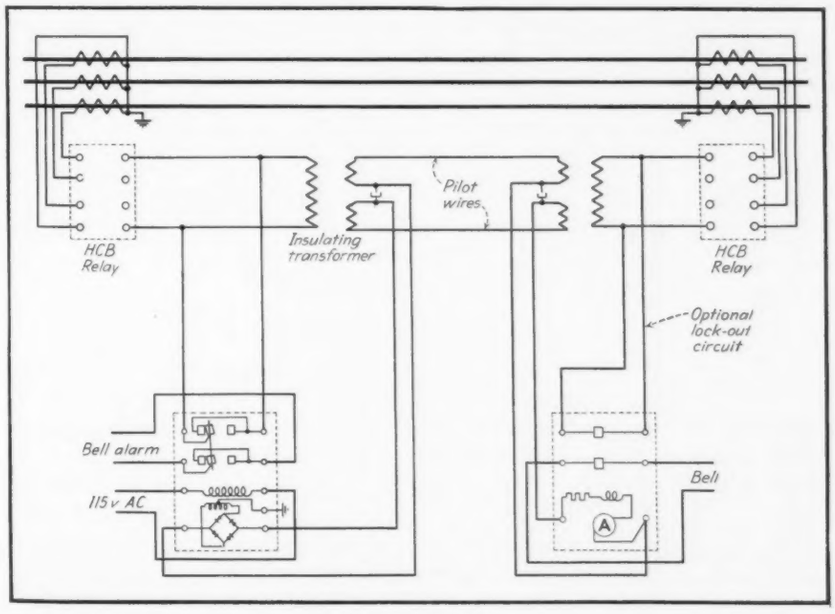
Supervisory Circuit Checks Relay System

By R. M. SMITH
Manager Relay Section, Westinghouse Electric & Manufacturing Company, Newark

Relays are the watchdogs of an electrical system. If they do not perform this operation dependably they are useless. A new, simple system has been devised for watching the relays—in this case a pilot-wire relay installation. It provides a continuous automatic check on the ability of the two pilot wires to carry relaying impulses. Heretofore the check has been made manually and only at periodic intervals. Conceivably, with this system, it would be possible for the pilot wires to become open-circuited or short-circuited after a check and before a time of relay operations without the operator being aware that the protective system is not on the job.

At the sending end a small amount of direct-current (four milliamperes or less) is imposed on the pilot wires at the midpoint of the insulating transformer. This current is provided by small dry-disk rectifiers energized through a small transformer connected to the alternating-current lines. At the receiving end of the system a high resistance is placed in parallel with a condenser at the midpoint of the insulating transformer. The condenser permits the relay impulses to pass unimpeded, but the high resistance to the direct current permits a short circuit to be detected even though it may occur at the far end of the pilot wire. Without the resistance, a fault at the far end of the line might not change the circuit impedance sufficiently for the relays to recognize the fault.

The relay at the sending end has both front and back contacts. As long as the current is normal the moving contact is held in the center position. Should the current either increase (indicative of a short circuit or ground) or decrease (indicative of open-circuit) the stationary contacts strike either the front or back contacts. This action results in some warning—either the sounding of a bell or lighting of a signal lamp.



D. C. SUPERVISORY CIRCUIT for HCB pilot wires

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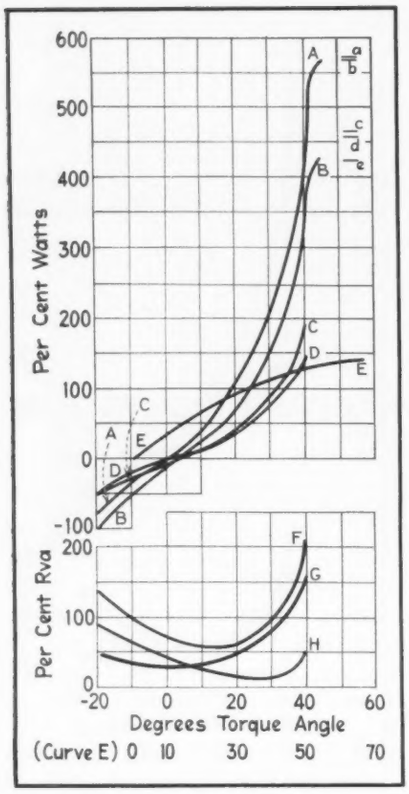
A Double-Speed Synchronous Machine

By ABE TILLES
Associate Professor of Electrical Engineering University of California

Performance characteristics of a double-speed rotating machine, secured from laboratory tests and confirming technical analysis, indicate that it could be advantageously applied to power systems, particularly in instances whereby a generator, synchronous or induction, at a smaller, perhaps unattended generating plant, is operated in parallel with a nearby larger plant, the combined output being transmitted from this second plant.

These characteristics include:

1. It delivers varying amounts of power synchronously at a constant speed.
2. It requires no field current supply or control gear.
3. Since it feeds no sustained power into a dead short circuit it requires a minimum of circuit breaker protection.
4. It supplies the leading rva. needed on long transmission without the reduction in inherent stability limit produced when this leading rva. is obtained from underexcited synchronous generators.
5. During a short circuit at a remote point with transmission intervening and machine terminal voltage substantially sustained, the conventional synchronous



POWER-ANGLE CURVES for double-speed machine with balanced voltages on rotor and stator show that stator and rotor winding divide total power delivery in half. As a generator, line rva. is sum of stator and rotor rva., but division shifts somewhat. As a motor, the machine runs similarly, but is not self-starting

LEGEND

A. Shaft watts. B. Total terminal watts.
C. Stator terminal watts. D. Rotor terminal watts.
E. Terminal watts for conventional machine.
F. Total rva. G. Rotor rva.
H. Stator rva.

Leading reactive volt-amperes in the generator and lagging reactive-volt-amperes in the motor are considered positive.

(a) Shaft watts predetermined from circle diagram for the observed maximum value of terminal watts.
(b) Shaft watts observed for the observed maximum value of terminal watts.
(c) Maximum terminal watts predetermined from circle diagram.
(d) Maximum terminal watts predetermined from vector diagram analysis neglecting losses.
(e) Maximum terminal watts observed.

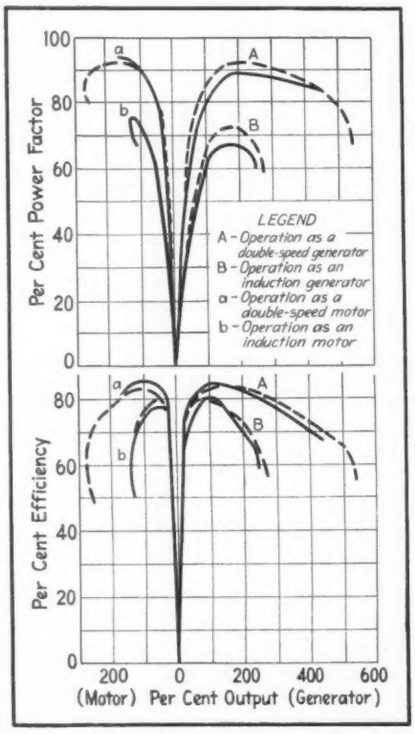
machine may fall out of step. A parallel induction generator cannot possibly supply overload initially as it could not do this without speeding up. The double-speed machine can supply overload from its own inertia and has a stability limit several times that of the conventional machine. It will, moreover, take the initial overload from a parallel conventional synchronous generator, thereby improving greatly the stability of both machines.

6. The double-speed machine has twice the rating of an induction machine for the same excitation rva. and the same load losses. It has, therefore, a substantially better power factor and efficiency.

A machine which, like an ordinary wound-rotor induction motor, is constructed with armature windings of the same number of poles on both rotor and stator can be operated as a synchronous machine by connecting *both* rotor and stator to the line in parallel. Allowance must be made, of course, for voltage ratio between the two windings, either by initially constructing the machine with a ratio close to unity, or otherwise, as by using a suitable transformer bank in the connection to one winding. Also, the rotor must be strong enough for double-speed operation. When one winding is energized and the machine driven at *double* its normal synchronous speed, the other winding may be synchronized with the line.

The stator armature currents produce a flux field rotating at normal synchronous speed, as usual. The rotor flux, likewise, sweeps past a rotor armature winding at synchronous speed. The necessary flux interaction is maintained by letting the rotor flux sweep backward relative to the rotor structure, while the rotor structure itself is turned forward at *twice* the usual synchronous speed.

Having no d.c. excitation circuit, the machine runs at any voltage set by other machines in parallel. It, therefore, delivers no sustained power or current into a short circuit. Such machines were proposed many years ago in European articles.


Per Cent Power Factor
Per Cent Efficiency
LEGEND
A - Operation as a double-speed generator
B - Operation as an induction generator
a - Operation as a double-speed motor
b - Operation as an induction motor
(Motor) Per Cent Output (Generator)

TESTS on identical machine run as double-speed unit and as induction unit show better efficiency and power factor obtained from double-speed operation

Note also the more extensive overload capacity of the double-speed machine. (Solid lines are observed values; dotted lines are values predetermined from circle diagram.)

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Automatically Lights Lamp in Reserve

By L. J. BUTTOLPH
Nela Park Engineering Department,
General Electric Company, Cleveland, Ohio

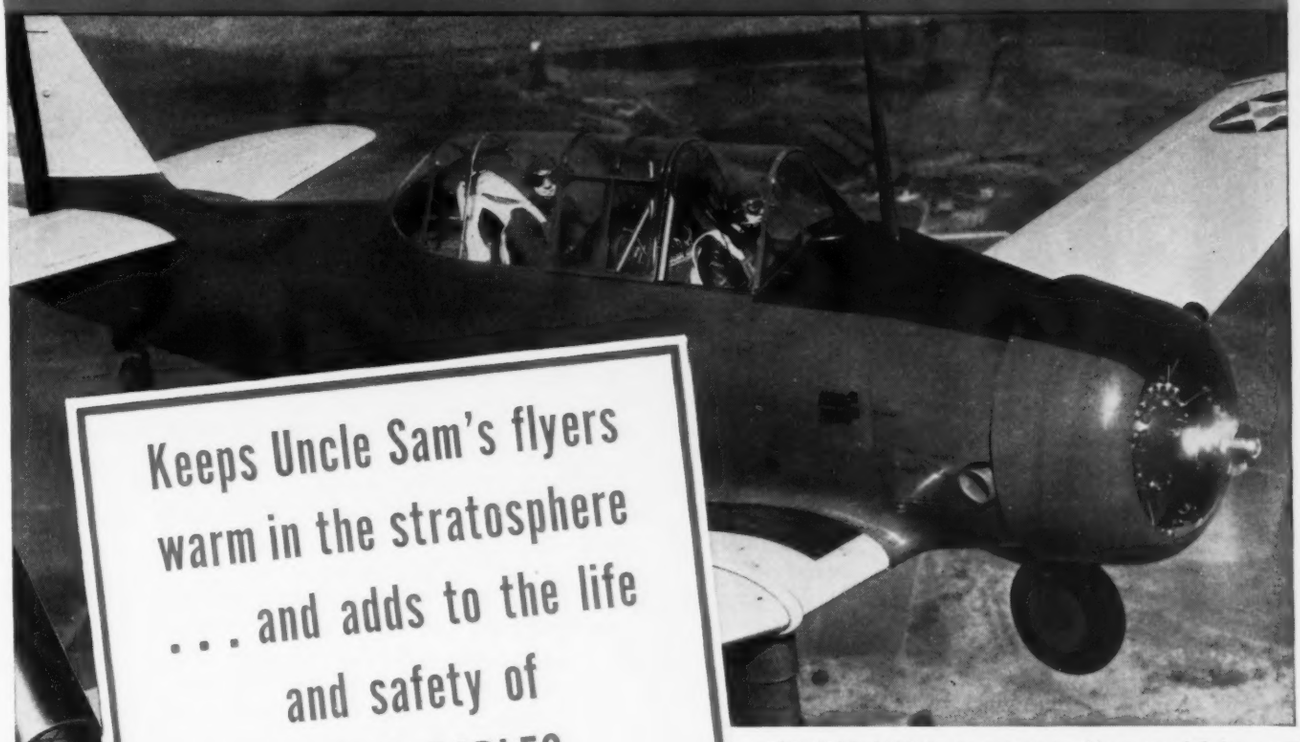
A novel operating circuit for electric discharge lamps, whereby an inoperative lamp may be automatically replaced electrically, but not mechanically, by an operative lamp, may be of value in certain floodlighting applications where an outage may be serious and where the illumination may come from either of two different sources.

When connected to the usual constant-voltage supply line, an electric discharge lamp has the characteristics of a "short circuit" on the line—of low and decreasing resistance—unless there is connected in series with it sufficient ballasting impedance continually to absorb the difference between the arc voltage drop and the supply voltage, both of which may change unpredictably.

When two similar discharge lamps of the type having arc-heated electrodes are connected in parallel through a single ballasting unit, one of the two lamps will ordinarily start more readily than the other, and, once started, will have an operating voltage somewhat lower than the other, with the result that but one of the two lamps will operate. If by chance both lamps start, one tends to take a momentary increase in current with a decrease in its apparent resistance, while the decrease in current to the other lamp is of course accompanied by an increase in its apparent resistance. These changes perpetuate themselves until one lamp finally takes all the current and the other lamp is extinguished.

Thus, if two discharge lamps of the same rating and electrical characteristics are connected in multiple to a single auxiliary device, only one of the two lamps will normally start and operate until that lamp fails, whereupon the second lamp will take up normal operation. It should be noted that, in general, there will be no control as to which of the two lamps will take the initiative in starting and operating.

CONDUCTING RUBBER makes it possible . . .



Keeps Uncle Sam's flyers warm in the stratosphere . . . and adds to the life and safety of POWER CABLES

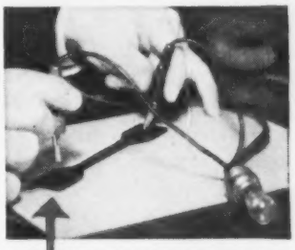
FLEXIBLE STRIPS of conducting rubber concealed in a new undersuit heat up like wires in a toaster; keep army stratosphere flyers warm at 60° below zero.

American Steel & Wire Company's Type PS Semi-Conducting Shielding (Conducting Rubber) eliminates electronic ionization of air gaps and adds years of service to the life of power cables.

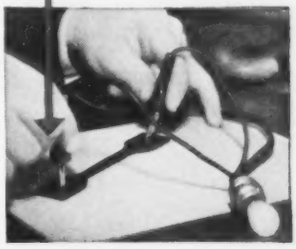
ORDINARY types of power cable shielding have one outstanding weakness. Bending the cable during installation or thermal expansion and contraction in service tends to separate the shielding from the underlying insulation—thus producing air gaps. At every point where such air gaps occur, gradual disintegration of the insulating compound results—and the life of the cable is reduced.

Now, American Steel and Wire Company's development of Type PS Semi-Conducting Shielding prolongs cable life by overcoming this difficulty. Type PS Semi-Conducting Shielding is always in intimate contact with the cable insulation. It is as flexible as rubber because it IS rubber—conducting rubber! When used with rubber insulation, Type PS Semi-Conducting Shielding not only adheres to the insulation, but becomes an integral part of its surface.

The problem of producing conductivity in rubber compound without sacrificing flexibility or other rubber-like properties has finally been solved. And we now offer a proven, thoroughly tested conducting rubber compound for use in power cable construction. Write today for more complete information.



THESE PHOTOGRAPHS taken in our laboratory show a 15 watt bulb being lighted by the flow of current from a 110 volt plug-in, through an ordinary "dumb-bell" sample of conducting rubber. These tests indicate that a wide range of conductivity in rubber is available, and this conductivity can be varied to suit the best design of the cable.



AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

UNITED STATES STEEL

LOAD BUILDING

Board Demonstrates Water Heater Wiring

By HUGH HEMPHILL
Kentucky Utilities Company, Maysville, Ky.

As a result of having made slight changes in the wiring of water heaters and of having used three types of time switches the Kentucky Utilities Company found that considerable confusion existed among the service men as to how a water heater should be connected. The method of wiring now standard with the company employs a 15-amp., 240-volt, three-wire master meter and a special combination meter and time switch. The meters are both socket type. Workmen unfamiliar with the required wiring might easily get connections mixed up. To clear up the confusion the company set up a training demonstration which has been so successful with company men that it will probably be offered to dealers and contractors for their employees.

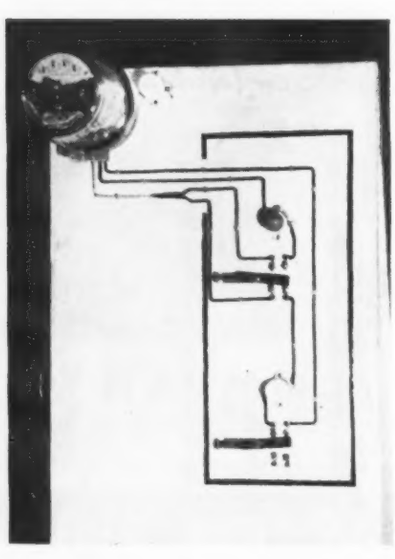
The off-peak water heating rate imposes four conditions on the meters:

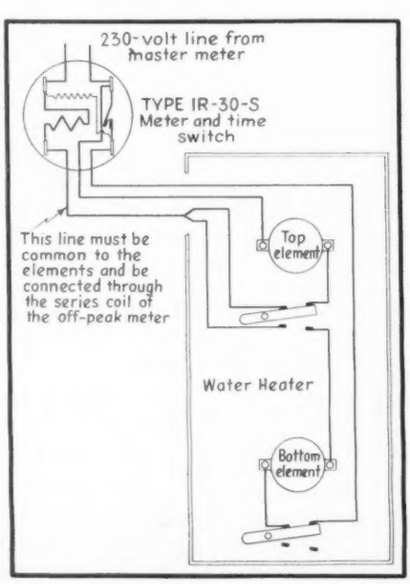
1. All energy supplied to the customer must be registered on the three-wire master meter.
2. All energy supplied to either the top or bottom element of the water heater during the off-peak period (10 p.m. to 8 a.m.) must be registered on the water heater meter. The off-peak energy is deducted from the total consumption registered on the master meter and billed at an off-peak rate.
3. The time switch must control the bottom element of the heater and the potential circuit of the off-peak meter. The bottom element of the heater cannot come on between 8 a.m. and 10 p.m. The potential circuit of the off-peak meter is energized only during the off-peak period.
4. The top element must be connected so as to be free to come on any time during the day that additional heat is required.

A portable board was built by the meter department to demonstrate these requirements in the proper installation of water heaters. Lamps are used to represent the elements of the heater and manually operated switches simulate the action of the thermostats. The lamps and switches are wired up through the standard combination meter and time switch and connected to a 120-volt supply. All wiring is visible and the circuit to the top and bottom elements are of different colored wire. The common wire to both elements is also a different color. By manipulation of the time switch and thermostats the complete operation of the water heater can be demonstrated.

Each service man at the demonstration is given a schematic drawing of the board. The drawing is large and as simple as possible and is more like a picture than an ordinary blueprint.

With such a picture as a guide it is easy to reconstruct the demonstration mentally.




230-volt line from master meter
TYPE IR-30-S Meter and time switch
This line must be common to the elements and be connected through the series coil of the off-peak meter
Top element
Water Heater
Bottom element

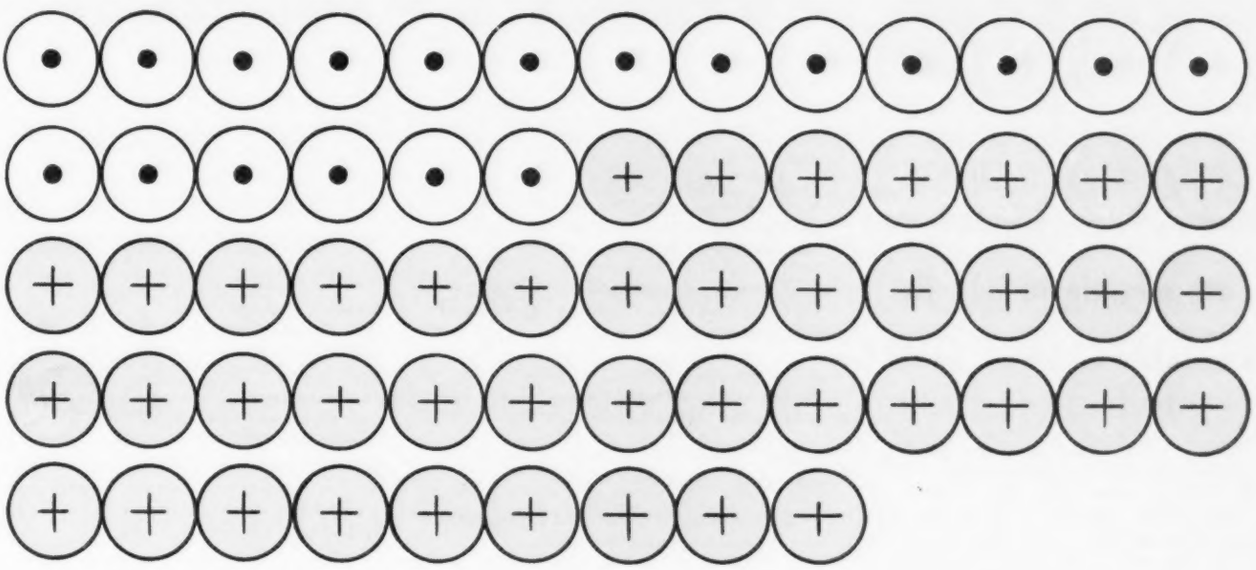
DEMONSTRATION BOARD and instruction diagram for service men

Utility Develops Electric Pig Brooder

A simple electric pig brooder that can be built by the average farmer at a cost of less than $10 is enjoying considerable popularity among the rural customers of one Midwestern utility. Farmers have found that by using the brooder pigs can be safely farrowed earlier in the year, usually late February or early March, and brought on the market in August, when prices are best.

Design of the brooder is not complicated. It consists of a three-sided, covered board shelter, with one side open, which can be installed in the

Invest in LATOX CABLES



(+) = YOUR DIVIDENDS

Imagine that you have a 19 conductor #16 solid rubber insulated control cable in a conduit. Under ordinary conditions of conduit fill it would require a 1¼ inch conduit. Suppose also that your 19 conductors are all in use and you need more circuits.

If you replace your present cable with a LATOX insulated control cable with #16 solid conductors you can get 61 conductors or more than three times the number of conductors you now have, yet the Simplex-LATOX cable will not take up any more space than the one you are now using. The extra 42 conductors are your dividends. The 61 conductor LATOX cable can go into the same 1¼ inch conduit. It is the simplest, easiest and least expensive way to increase the service capacity of your control cables and conduits.

We shall be glad to send you a copy of our new LATOX Data Sheet #101, which is just off the press. A card or a letter will bring it to you promptly.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge, Mass.

Simplex – LATOX

Thin insulation made directly from rubber latex

ARE YOU A FORTY-NINER?

Find out now whether you are eligible to join the 49-FOOTCANDLE CLUB!

THE old Forty-Niners were hardy pioneers who tried and sometimes succeeded in wresting golden treasures from Mother Earth. The modern Forty-Niners are those who seek and discover the rewards which the treasure of good lighting brings.

Today there are many general lighting installations averaging 50 footcandles or more, but the fact remains that there are many lighting installations going in far below that.

This is so, oftentimes, not because of the original cost or the cost of maintenance, but because either the seller or buyer, or both, do not understand the full benefits of more light and better lighting, as demonstrated in the years of laboratory work which led to the Science of Seeing.

WHY THE 49-FOOTCANDLE CLUB? It was to dramatize the idea of 50 footcandles and to give it some of the romance and color of the old Forty-Niners that the 49-Footcandle Club was organized. Although the rules and regulations for membership in the Forty-Niners are based on 49 footcandles or better, this exact level of lighting is not the important thing. The main object is to stress 49 or 50 footcandles as a definite means of emphasizing the importance of the Science of Seeing and its benefits for commerce and industry.

5-POINT PROGRAM. The purpose of the Forty-Niners' Club is five-fold . . . each point is backed with the thought of the advantages that better lighting offers the consumer:

1. To focus attention on the consumer advantages of higher levels of commercial and industrial lighting.

2. To supply recognition to utility, manufacturer, and jobber lighting salesmen who sell better installations.

3. To enhance interest in the Science of Seeing and to remind people of the basic reasons for 50-footcandle lighting.

4. To interest executives in 50-footcandle lighting for their own offices.

5. To stimulate interest and conversation about better lighting generally.

WHO IS ELIGIBLE TO JOIN? Membership in the Forty-Niners' Club is open to any lighting salesman (utility, distributor, or manufacturer) who is primarily responsible for selling a lighting installation totalling 49 or more *maintained* footcandles.

In order to qualify, an installation must have been sold since September 1, 1940 and must be for 49 maintained footcandles or more of general lighting for at least: 200 square feet of office space, 500 square feet of commercial space, or 2000 square feet of industrial space.

HONORARY MEMBERSHIPS TOO. While active membership in the Forty-Niners will be for those who sell the benefits of modern lighting levels, any executive who works under 49 or more maintained footcandles of general lighting is eligible to honorary membership.

AN EMBLEM OF ACHIEVEMENT. Members and honorary members of the Forty-Niners will receive the Forty-Niner emblem—a neat lapel button, as shown here. Aside from the privilege of wearing the emblem, it should serve as a constant reminder of what it stands for. It will also help provoke conversation and will give many opportunities to explain the desirability of better lighting.

GET COMPLETE INFORMATION ABOUT "THE FORTY-NINERS" TODAY!

For complete information about the 49-Footcandle Club, see your General Electric lamp representative. He can give you copies of the simple application card and complete instructions for filling it out on each 49 footcandle installation. Get in touch with him today! General Electric Co., Nela Park, Cleveland, Ohio.

"NUGGETEERS" TO WIN GOLD NUGGET EMBLEM!

Special deluxe, solid-gold nugget emblems as shown above will be awarded the 49-ers who keep right on selling 49-footcandle (or better) installations. Each regularly enrolled member who *sells* five or more of these installations will be able to qualify for the Order of Nuggeteers.

G-E MAZDA LAMPS
GENERAL ELECTRIC
Made to stay brighter longer

HERE'S THE ROLL OF 49-ER MEMBERS*

(AS OF APRIL 17, 1941)

Rodney Albright, Contractor, Coldwater, Mich.

Ray Anderson, Anderson & Veatch, Evansville, Ind.

Raymond D. Arenberg, Commonwealth Edison Co., Chicago, Ill.

W. L. Arnold, Nashville Electric Service Co., Nashville, Tenn.

Frank R. Auchy, Philadelphia Electric Co., Philadelphia, Pa.

C. G. Baffer, Lincoln Park Tool & Die Co., Lincoln Park, Mich.

V. K. Ballard, St. Joseph Ry. Lt. Ht. & Pr. Co., St. Joseph, Mo.

C. A. Beatty, Appalachian Electric Power Co., Williamson, W. Va.

Ernest Benson, Benson Manufacturing Co., Kansas City, Mo.

J. N. Bess, G. E. Supply Corp., Columbia, Mo.

L. Bogardus, Packard Motor Co., Detroit, Mich.

Walter Boschen, Boschen Co., Architects, St. Joseph, Mo.

Morris G. Braden, Minnesota Power & Light Co., Duluth, Minn.

W. P. Browning, Ben Williamson Co., Ashland, Ky.

Clinton E. Brush III, Architect, Nashville, Tenn.

Joseph Calley, Murray Corporation of America, Detroit, Mich.

Henry G. Clum, Jersey Central Power & Light Co., Asbury Park, N. J.

J. H. W. Conklin, Consumers Power Co., Battle Creek, Mich.

A. P. Corcilius, New York State Electric & Gas Corp., Oneonta, N. Y.

R. S. Cowan, Graybar Electric Co., Detroit, Mich.

Jerry Culligan, Fort Dodge Gas & Electric Co., Fort Dodge, Iowa

A. Ray Cumming, Public Service Co. of New Hampshire, Manchester, N. H.

Donal M. Daley, G. E. Supply Corp., Detroit, Mich.

W. H. Danforth, Litecontrol Corp., Boston, Mass.

Fred H. Davis, Durham Public Service Co., Durham, N. C.

Paul De Leon, Wisconsin Power & Light Co. Madison, Wisc.

Norman J. DeYoung, DeYoung Electric Co., Fairmont, Minn.

C. E. Ellis, G.E. Supply Corp., Philadelphia, Pa.

Paul Felx, Southern Indiana Gas & Electric Co., Evansville, Ind.

H. B. Fife, Fife-Pearce Electric Co., Detroit, Mich.

Erna Fisher, The Hartford Electric Light Co., Hartford, Conn.

M. W. Fitzsimonds, G.E. Supply Corp., Portland, Oregon

R. E. Furbay, Furbay-Sommer Co., Canton, Ohio

A. H. Gatward, Turner Electric Supply Co., Detroit, Mich.

W. Trent German, Southern California Edison Co., Whittier, Calif.

T. F. Gessner, Detroit Edison Co., Detroit, Mich.

Mack Gilbert, Nashville Electric Service Co., Nashville, Tenn.

Ernest Glick, Broadstreet's Inc., Chicago, Ill.

Lawrence Goble, Indiana Service Corp. Fort Wayne, Ind.

Harry Gold, Sun Ray Drug Co., Philadelphia, Pa.

David Goldberg, Princess Shop, Huntington, W. Va.

W. D. Gorman, The Hartford Electric Light Co., Hartford, Conn.

W. G. Graham, Philadelphia Electric Co., Philadelphia, Pa.

John A. Hand, Indiana General Service Corp., Muncie, Ind.

G. K. Hardacre, Public Service Co. of Northern Illinois, Chicago, Ill.

Russell M. Harding, Buffalo Niagara Electric Corp., Buffalo, N. Y.

George D. Hansman, St. Joseph Ry. Lt. Ht. & Pr. Co., St. Joseph, Mo.

Peter B. Hansen, Graybar Electric Co., Minneapolis, Minn.

Day L. Harper, Graybar Electric Co., Minneapolis, Minn.

R. F. Hartenstein, Ohio Edison Co., Akron, Ohio

Marshall A. Havenhill, Kansas City Power & Light Co., Kansas City, Mo.

John D. Haverkamp, New Orleans Public Service, Inc., New Orleans, La.

W. C. Hawkins, Louisiana Power & Light Co., Metairie, La.

P. Hebert, Louisiana Power & Light Co., Metairie, La.

R. E. Heisey, Bulldog Electric Co., Detroit, Mich.

F. E. Held, G.E. Supply Corp., Akron, Ohio

Norman B. Hickox, Chicago, Ill.

Dezane M. Hoffman, Philadelphia Electric Co., Philadelphia, Pa.

E. A. Holloway, Iowa Electric Light & Power Co., Cedar Rapids, Iowa

Ralph L. Huse, Graybar Electric Co., Boston, Mass.

W. P. Hutcheck, Artcraft Electric Supply Co., Wilmington, Delaware

Glade Ives, Graybar Electric Co., Kansas City, Mo.

Frank F. Johnson, New York Power & Light Corp., Schenectady, N. Y.

V. E. Jones, G.E. Supply Corp., Detroit, Mich.

Phil C. Keller, The Miller Co., Cleveland, Ohio

Emery F. Kennedy, Jr., Commercial Reflector & Mfg. Co., Los Angeles, Calif.

E. M. Kerr, G.E. Supply Corp., Portland, Oregon

Morris Klaus, Wolverine Light Supply Co., Detroit, Mich.

Robert E. Lange, Eoff Electric Co., Salem, Oregon

W. M. Langstaff, Appalachian Electric Power Co., Huntington, W. Va.

Nicholas Leopold, Philadelphia Electric Co., Philadelphia, Pa.

E. H. Lindsay, St. Joseph Ry. Lt. Ht. & Pr. Co., St. Joseph, Mo.

G. A. Litsinger, Appalachian Electric Power Co., Charleston, W. Va.

Charles C. Lucas, Mill Power Supply Co., Charlotte, N. C.

R. A. Macomb, Kentucky & West Virginia Power Co., Ashland, Ky.

E. G. Mangold, Ohio Edison Co., Akron, Ohio

Thomas A. Marshall, Edwin F. Guth Co., Cincinnati, Ohio

Howard J. Martin, Curtis Lighting, Inc., Milwaukee, Wis.

Anthony L. McCabe, Light Control Corp., Boston, Mass.

William M. McConnell, Commonwealth Edison Co., Chicago, Ill.

E. G. McGlinchey, St. Joseph Ry. Lt. Ht. & Pr. Co., St. Joseph, Mo.

J. J. McGrath, Marshall Field & Co., Chicago, Ill.

E. C. Melaas, Wisconsin Power & Light Co., Beloit, Wisconsin

W. F. Minor, The Miller Co., Meriden, Conn.

Walter C. Moore, Light Control Corp., Boston, Mass.

E. G. Mortensen, Nebraska Power Co., Omaha, Nebraska

C. C. Munroe, Jr., Fife Electric Supply Co., Detroit, Mich.

Charles R. Murphy, G.E. Supply Corp., Avondale Estates, Ga.

**G-E Members are not included*

E. A. Murray, Jr., Appalachian Electric Power Co., Huntington, W. Va.

R. S. Musgrave, Appalachian Electric Power Co., Huntington, W. Va.

S. R. Naysmith, The Miller Co., Meriden, Conn.

Harry L. Nicol, G.E. Supply Corp., Detroit, Mich.

Joseph A. Noser, Union Electric Co. of Missouri, St. Louis, Mo.

Joseph Optican, St. Joseph, Mo.

Emil J. N. Ott, Jr., Pacific Gas & Electric Co., Sacramento, Calif.

B. L. Palm, Central Illinois Public Service Co., Springfield, Ill.

Philip Peeples, Georgia Power Co., Atlanta, Ga.

J. R. Pershall, Public Service Co., of Northern Illinois, Chicago, Ill.

T. H. Posey, Commonwealth Edison Co., Chicago, Ill.

R. Potter, Northampton Electric Lighting Co., Northampton, Mass.

P. H. Powers, West Penn Power Co., Pittsburgh, Pa.

M. L. Putney, G.E. Supply Corp., Louisville, Ky.

J. D. Rhoads, Graybar Electric Co., Baltimore, Md.

Harold M. Richards, Virginian Electric, Inc., Charleston, W. Va.

Edwin L. Riego, Marshall Field & Co., Chicago, Ill.

F. A. Riley, G.E. Supply Corp., Springfield, Mass.

H. A. Roseberry, Graybar Electric Co., Detroit, Mich.

F. K. Rossitor, G.E. Supply Corp., Omaha, Nebraska

John J. Rutherford, Jr., Philadelphia Electric Co., Philadelphia, Pa.

Harry Ryan, Shepherd Electric Co., Baltimore, Md.

John H. K. Shannahan, Indiana Service Corp., Fort Wayne, Ind.

James Shute, Uxbridge Worsted Co., Uxbridge, Mass.

Raymond L. Smart, Boston Edison Co., Boston, Mass.

Chester C. Smith, Kansas City Power & Light Co., Kansas City, Mo.

F. H. Smith, Appalachian Electric Power Co., Williamson, W. Va.

Oscar Smith, Kansas City Power & Light Co., Kansas City, Mo.

Arno Spiegel, Protective Electric Supply Co., Fort Wayne, Ind.

George Struthers, Graybar Electric Co., Detroit, Mich.

C. B. Talley, Appalachian Electric Power Co., Charleston, W. Va.

Fred Telder, G.E. Supply Corp., Kalamazoo, Mich.

E. E. Thacker, Jr., Bluefield Supply Co., Bluefield, W. Va.

L. G. Tighe, Ohio Edison Co., Akron, Ohio

Don Trefry, Detroit Edison Co., Detroit, Mich.

Bernie Uhr, The Uhr Electric Co., Philadelphia, Penna.

Donald E. Vincent, Central New York Power Corp., Syracuse, N. Y.

A. J. Von Burg, Wisconsin Power and Light Co., Madison, Wis.

Charles J. Weedin, Puget Sound Power and Light Co., Wenatchee, Wash.

George E. Whitwell, Philadelphia Electric Co., Philadelphia, Pa.

Tilghman Whitley, Louisiana Power & Light Co., Gretna, La.

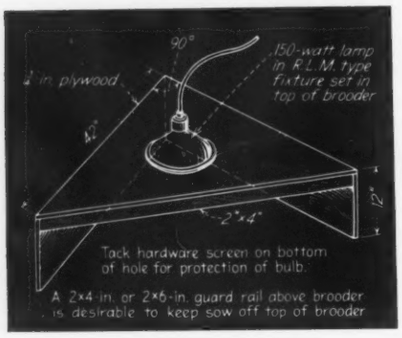
Leland A. Wilson, Van Meter Co., Cedar Rapids, Iowa

E. Burton Wolfe, Daybrite Reflector Co., Detroit, Mich.

J. C. Young, Jr., Iowa Electric Light & Power Co., Cedar Rapids, Iowa

corner of the sty. A 150-watt lamp and R.L.M. type reflector fitted in the top of the shelter supplies the necessary heat.

One Illinois farmer, who had several sows, built four of these brooders and installed them in separate unused horse stables. By staggering the


90°
150-watt lamp in R.L.M. type fixture set in top of brooder
¼ in. plywood
42"
12"
2"x4"
Tack hardware screen on bottom of hole for protection of bulb.
A 2x4-in. or 2x6-in. guard rail above brooder is desirable to keep sow off top of brooder

ELECTRIC heated pig brooder, big enough for one litter, can be built for under $10

farrowing period of his swine he was able to put each sow and litter in a stable with a brooder for about ten days after farrowing. In this way he was able to put all his "first of March" pigs through in time for a top 7-cent price in August, and made a neat profit on the transaction.

•

"Make Every Home" Employees' Campaign

The story of the "Make Every Home" campaign of the Community Public Service Company, while not particularly spectacular in terms of the actual gross load and revenue added, deserves to be told because it is the story of a whole-hearted employee effort and what that effort can do to build load for a company which, because of the nature of its territory, must operate without a formal sales organization.

To set the stage a little: Community Public Service Company, with headquarters in Ft. Worth, Texas, serves 167 small towns and communities with an aggregate population of 128,410, or 769 per town on the average. Of these towns, 121 are scattered across Texas from the Panhandle to the Gulf Coast, eleven are in southwestern New Mexico, 31 in Kentucky and a small group in northern Louisiana.

In all, there are 34,868 electric customers. Approximately 209 per town. A total of 275 electric employees—less than two per town—handle the company's business and do all the selling.

When the company set out in the fall of 1939 to contact every customer, in an eight-week "Make Every Home" lighting sales campaign, it meant that every electrical employee would have to contact, on the average, 127 customers to do the job laid out, *if they worked alone.* But they didn't. Not only regular employees but wives of employees and extra employees contributed their efforts. As a result, more than 90 per cent of the customers were called on in most of the districts and a large percentage sold better lighting in one form or another. In *three towns on the system every customer was sold some piece of lighting equipment.*

Results

When the campaign statistics were compiled it was found that lamp bulb sales reached the impressive total of 2,672,222 watts for an average of 76.3 watts per lamp. We have no way of knowing how many non-employees contributed to this total, but on an electrical employee basis this represents 9.7 kw. per employee. Besides lamp bulbs, the campaign featured I.E.S. lamps and the company reports a total of 1,242 units sold for an average of 4.5 per employee. Non-I.E.S. lamp units sold aggregate 1,661, or 6.04 per employee. Some index of individual performance is given by the fact that 26 employees sold ten I.E.S. lamps or more, and one employee, Joetta Colwell of Pecos, Texas, sold 43 during the campaign.

•

Better Light for Home Students

Featuring the benefits of improved lighting in the home for students, the Boston Edison Company effectively contrasted old and modern methods in a cottage at the recent Book Fair in the Boston Garden.

At the right window was shown a study room lighted by a 40-watt bulb in an antiquated gooseneck fixture and at the left a similar room equipped with a 100-watt student desk lamp and a 100-200-300-watt floor lamp having three 40-watt candelabras in addition to the larger bulbs. 200-watt lamp of the main unit sufficed with the candelabras to provide a display emphasizing the likely coincidence of good marks and good lighting, together with that of bad marks and bad lighting.

Double accent was achieved by arranging the exhibit for high visibility both inside and outside the cottage. The home-lighting division of the company sponsored the display and obtained many leads for better illumination from visitors during the six days of the fair.

ILLUMINATION contrasts arouse interest at Boston Book Fair. Display contrasts high marks at school and 200 watts of lighting (left window) with low marks at school and 40 watts of lighting (right window)

3 great Fluorescent lighting benefits!

1. All the light you need now
2. Quicker, less expensive installation
3. Freedom to rearrange operating equipment without changing lighting

TO UTILITY LIGHTING ENGINEERS!

The Miller Company believes that the intelligent way to work with you—is to tell the same story you do—the story of direct benefits to the user from modern and efficient lighting. This particular advertisement is currently reaching more than 500,000 power users with *that kind* of story. It is part of a regular planned monthly program.

... with IVANHOE "50 FOOT CANDLER" RLM *Continuous Wireway* FLUORESCENT LIGHTING SYSTEM

● IVANHOE FLUORESCENT "50 FOOT CANDLER" offers these 3 great lighting benefits to key industries—aviation plants, textile mills, manufacturing plants of all types. IVANHOE "50 FOOT CANDLER" will do these profitable things for you because it is *not* a lighting fixture but a *lighting system*...the first RLM *Continuous Wireway* Fluorescent Lighting *System* providing new higher levels of illumination at economical cost.

In one case, for example, a well-known manufacturer made a net saving of $8,000! In another, a key Defense plant, the operating cost of "50 FOOT CANDLERS" was but a fraction of a cent per man-hour of production! In still another case, exclusive features of the "50 FOOT CANDLER" gave the user the option of adding a third lamp for a 45% increase in illumination when, as and if he needed it!

Think what similar benefits could mean to you in your plant right now! Then . . .

Write today for new "50 FOOT CANDLER" Bulletin 1C.

IVANHOE

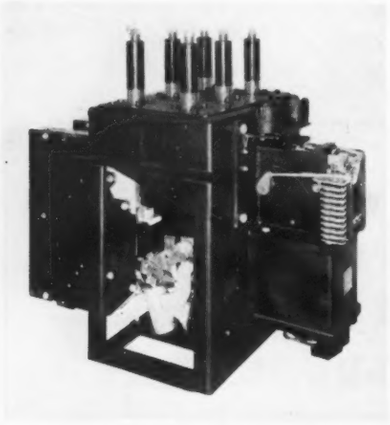
THE MARK OF A COMPLETE LIGHTING SERVICE

THE MILLER COMPANY
MERIDEN, CONN.
Pioneers in Good Lighting Since 1844

NEW EQUIPMENT

Circuit Breaker

Magne-blast type circuit breaker of higher rating is available for applications in steel mills, chemical, automotive and industrial plants, as well as in central stations. It is rated 250,000 kva. for services from 4,200 to 7,500 volts. Higher insulation and service voltage ratings have been obtanied by co-ordination of insulation in the arc chute, increased phase spacing and a separate box carrier for each phase.



Type "AM-10-25" magne-blast circuit breaker, 7,500 volts, 1,200 amp. **General Electric Co.**, Schenectady, N. Y.

•

Connectors

Plate grounding connectors; maximum wire sizes Nos. 4, 1/0, 4/0 and 500,000 cir.mil. **Frankel Connector Co.**, 177 Hudson St., New York, N. Y.

Connectors clamp one, two or three grounding cables to a flat surface. Connector bodies, of Electrical bronze, have smooth cast wire groove and a ground plate contact surface. Standard sizes with Everdur hardware with oval shank bolts clamp to ⅜-in. plate.

•

Resistors

Type "FL" resistor. **International Resistance Company**, 401 N. Broad St., Philadelphia, Pa.

For d.-c. operation of fluorescent lamps, the resistance units are wire wound with molded 1,250-volt insulation topped by a metal strip to aid in heat dissipation, and are sufficiently small to fit in the fixture channel. Units are said to operate at a temperature rise of from approximately 40 to 50 deg. C. Available in a complete line of voltages and sizes to fit standard wiring strips.

•

Heat-treating Machine

Two new models of high-frequency heat-treating machines are offered, one for applications for forming and forging; other for localized "Tocco"-hardening. In the hardening machine, a transformer housing and work pan have been added to the otherwise flat-topped basic unit. Both models, 20 kw. output, use the same high-frequency motor-generator sets, supplying 9,600 cycles of high-frequency current at 220 volts, and have required control devices.

Model "Tocco Junior" heat-treating machine; capacity 20 kw. output; transformer housing unit for hardening. **The Ohio Crankshaft Co.**, Cleveland, Ohio.

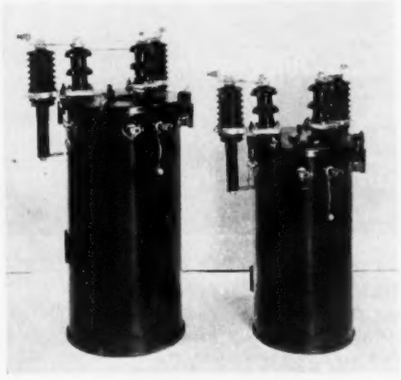
Who Makes What?

"Electrical Buyers Reference," published annually. **Electrical World**, 330 West 42d St., New York, N. Y.

Names, addresses and products of electrical manufacturers are catalogued in this convenient, annual publication for public utility, industrial, engineering and other major electrical buying interests.

Transformers

For outdoor use on distribution systems, a new line of smaller, lighter transformers use "Hipersil," a new magnetic steel which has a flux-carrying capacity of about one-third greater than that of ordinary silicon steel. This facilitates reductions in size and weight as much as 25 per cent in some sizes. Reduced impedance, especially in units smaller than 25 kva., has improved voltage regulation on the average of 10 per cent. Lowered thermal gradients between coils and insulating oil have increased short-time overload capacity. In single-phase units maintenance is simplified by a new type of wound core, fabricated into two solid pieces that are strapped together around the coils. If coils need replacing, the operation can be performed quickly by removing the strap and lifting one-half of the core out of position. Three-phase units have stacked cores similar to those used in conventional transformers.



Hipersil distribution transformer (right). Sizes ½ to 500 kva. for 2,400, 4,800, and 7,200 volts; size 10 kva. illustrated. **Westinghouse Electric & Mfg. Co.**, East Pittsburgh, Pa.

•

Industrial Fluorescent

Model "2026" fluorescent industrial unit; uses two 100-watt lamps; corrected for power factor and stroboscopic effect; for 110-125 or 220 to 250 volts a.c. **Mitchell Mfg. Co.**, Chicago, Ill.

Designed for large-area, high-intensity lighting in industrial locations, this fixture uses two of the recently announced 100-watt, "T-17" lamps. Vitreous porcelain finish reflector provides an even spread of light with a 13-deg. angle cut-off, the

company states. Ends of unit are closed, with ventilating louvres on top and ends of fixture.

•

Cable Reel Jack

New addition to a line of jacks has been announced, for handling cable reel so that cable, wire rope, barbed wire or rope can be paid out or rolled onto the

Model "3-CR" ratchet type cable reel jack. Capacity 15 tons. **Templeton, Kenly & Co.**, Chicago, Ill.

reel. These jacks are adaptable for stringing communication lines and power line construction; used in pairs, one on each side of the reel. Ratchets provide for fast lifting and lowering of either loaded or empty reels. Lifting hook on head of jack accommodates spindles up to 2¼ in. in diameter.

•

Cooking Appliance

Domestic electric cooking appliance may be used for cooking complete meals, for broiling, roasting, frying, baking, warming, canning, as well as storing idle utensils. An 18-qt. roaster oven is glass-wool insulated, regulated by themostat with signal-light control, and may be turned on and off automatically by a time

"NESCO CHEF" cooking unit, 110-120 volts. **National Enameling & Stamping Co.**, Milwaukee, Wis.

clock. Surface and broiler unit, with three-heat switch, has 600-, 1,200- and 1,600-watt combinations. Oven element, 1,320 watts, controlled by bi-metallic thermostat. Appliance furnished with plug attachment for operation on 110–120-volt service.

•

Tachometer

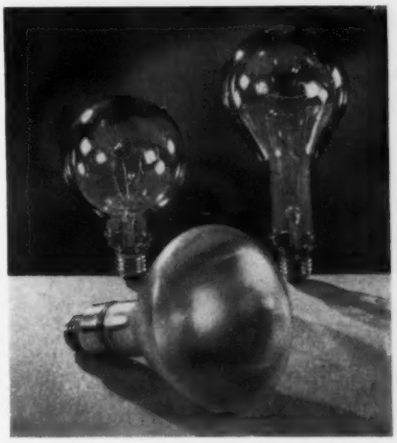
A.c. tachometer. **Westinghouse Electric & Mfg. Co.**, East Pittsburgh, Pa.

New a.c. tachometer, without brushes or commutator, has been developed to overcome undesirable features of the conventional d.c. tachometer. A.c. voltage generated is rectified and indicated in terms of rotational or linear speeds; calibrations can be in revolutions per minute, feet per minute, gallons per minute, or other units depending on the application. Non-sparking generator permits use of instrument where explosive vapors are present.

•

Infra-red Lamps

Three new infra-red heat lamps have been announced by the company. Two of the lamps have clear bulbs, for use with the standard gold-plated or "Alzac" reflectors. The third lamp does not require any separate reflector since it has its own reflector lining sealed inside to keep it free from oxidation and the collection of dust, dirt and fumes. The manufacturer



Infra-red heat lamps; 250 watts, 105-120 volts. **Birdseye Div., Wabash Appliance Corp.**, Brooklyn, N. Y.

states that the reflector lining will keep heat-reflecting value for the 6,000-hour life of the bulb because it is made of pure solid silver which is sealed inside the gas-filled bulb.

•

Air-Conditioning Units

Models "40," "61-A," "76-A" air-conditioning units for window mounting; cooling capacity, 3,675 B.t.u., 5,750 B.t.u. and 7,500 B.t.u., respectively. Model 91A, console cabinet, 9,100 B.t.u. **Philco Corp.**, Philadelphia, Pa.

Four new models of portable air-conditioning units, three window units and one floor cabinet model, have been announced by the company. Units cool, dehumidify, filter and circulate air. Largest window and floor models deflect air stream from almost horizontal to vertical.

BETWEEN
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SEE OPPOSITE PAGE
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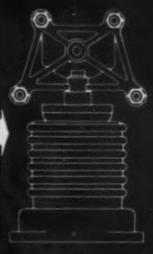
Insert top and bottom. 7.5 to 34.5 KV. Meets all NEMA requirements for strength and flashover values.
CLASS
B-4, 5 and 7
Insert top and outside bonded base. 7.5 to 34.5 KV. Meets all NEMA requirements for strength and flashover values.

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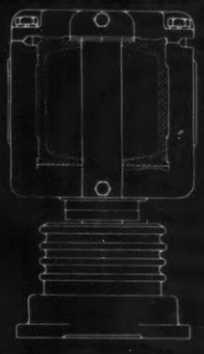
for 5, 6, and 7 inch size double channel.

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CRESCENT CABLES SUPPLY POWER for DEFENSE

ARMORED CABLE • FLEXIBLE CORDS • LEAD ENCASED AND PARKWAY CABLES • VARNISHED CAMBRIC

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CONTROL CABLES
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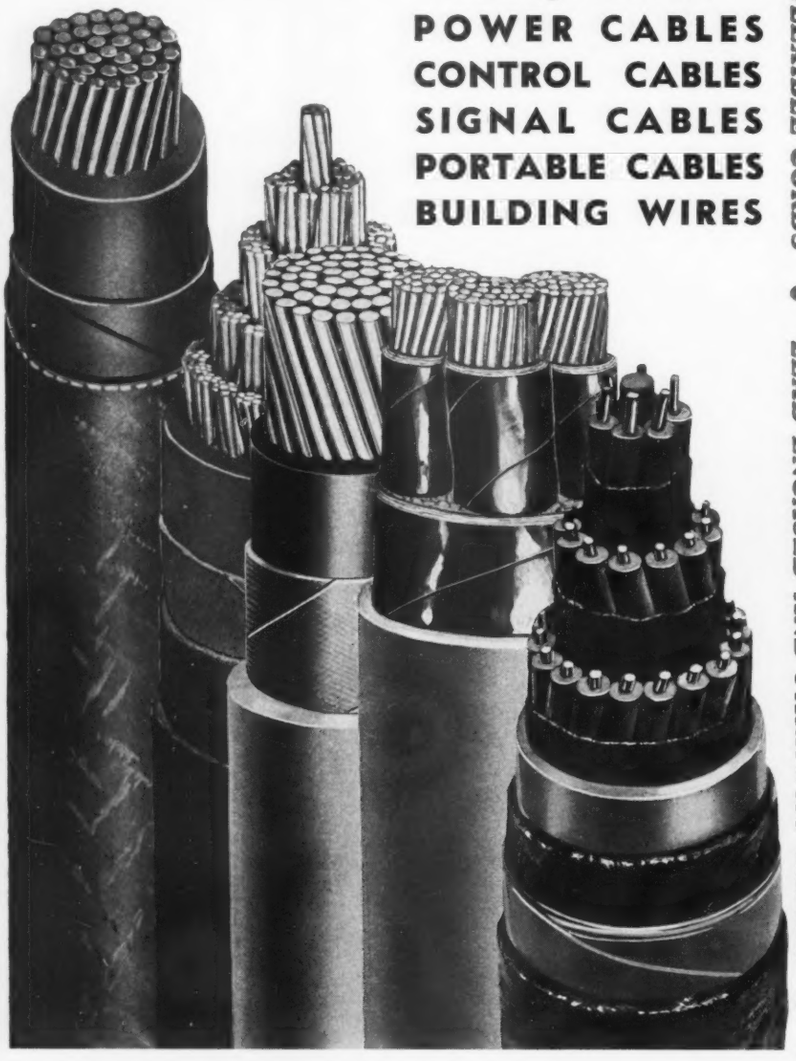


CRESCENT INSULATED WIRE & CABLE CO.

CRESCENT
WIRE and CABLE

Factory: TRENTON, N. J.—*Stocks in Principal Cities*

CRESCENT ENDURITE SUPER - AGING INSULATION

TECHNICAL LITERATURE

WIRE—Specifications for building wire and cable—single and multiple conductor, rubber and synthetic insulated, fibrous and lead covered—also fixture wire, non-metallic sheathed cables, service entrance, service drop and underground service entrance cables are contained in a new 52-page publication issued by United States Rubber Co., Rockefeller Center, New York, N. Y. Tables on wire gages, solid and stranded copper wire and conduit are included.

REPORT—"Distribution Transformer Load Supervision" is the subject of a report of the Overhead Distribution Group of the Transmission and Distribution Committee, Edison Electric Institute. This report outlines various methods in use, including both field testing and office record examinations, to determine the actual loads being carried. Methods are given for analyzing local conditions to determine criteria for maximum allowable loading. Copy may be obtained from Edison Electric Institute, 420 Lexington Ave., New York, N. Y. Price $1.50 to non-members in U.S.A.

CONTROL SELECTION CHART—A new publication, "How to Select Control for D.C. Motors," explains in simple language the functions of a d.c. controller, types of control, protection afforded by d.c. control and methods of starting and stopping d.c. motors. The chart in the center spread lists features, enabling the user of d.c. motors to make a selection of manual, magnetic, non-reversing and reversing control. The six-page publication, GEA-3531, is issued by the General Electric Co., Schenectady, N. Y.

PROTECTIVE LIGHTING—An engineering bulletin, "Protective Lighting for Industrial Plants," has been issued by and may be obtained from the Holophane Company, Inc., 342 Madison Ave., New York, N. Y. It gives data on mounting heights and spacing of fixtures for fence and general and localized yard lighting, also light distribution curves and illustrations on application of various light distributions to different practical conditions.

INDEX—American standards, adapted and proposed, representing general agreement as to best current practices in various industrial fields and in fields of industrial and public safety, are listed by designation number and alphabetically in A.S.A. publication No. 1401. Copy of the sixteen-page index may be obtained from American Standards Association, 29 West 39th St., New York, N. Y.

RUBBER—"Effect of Carbon Black on Electrical Conductivity of Rubber" is a summary covering recent results of further studies on compounding carbon black in rubber. It is included in a four-page issue of Carbon Black Bulletin, available from Godfrey L. Cabot, Inc., Boston, Mass.

INDUSTRIAL WIRING—Bulletin No. 403, published by Bull Dog Electric Products Co., 7610 Jos. Campau Ave., Detroit, Mich., discusses the application of "BUStribution duct system" for industrial plants and commercial buildings. Typical layouts are diagrammed and information is included telling how to estimate a job using this duct system.

MANUFACTURING - MARKETS

Defense Work Rushed by General Electric

Substantial progress toward getting its defense work in "high gear" was reported by General Electric Co. in a statement to stockholders accompanying the quarterly dividend checks.

Chairman Philip D. Reed and President Charles E. Wilson stated that much of the blueprint and tooling-up stage had been left behind and that the company is now at a point where "much of the equipment so urgently needed is coming off the production lines in steadily increasing quantities."

New factories have been built at a cost of $50,000,000, it was said. Orders now total $500,000,000, 75 per cent for defense. About 105,000 people are now on the payrolls.

The company is employing hundreds of subcontractors in an effort to expedite its defense contracts and is seeking additional concerns able to handle precision work of the type required by Army and Navy specifications.

Beginning immediately, the extension of resources of the company, normally concerned with research and development of radio and television receivers and electronic tubes, will be devoted in a large measure to vital defense production of an electronic nature for which a sudden need has arisen, Mr. Wilson said.

•

Let $2,325,000 Contracts for Watts Bar Plant

TVA has awarded contracts for equipment for a third generating unit at the power plant at Watts Bar Dam. The initial station was designed for a capacity of 120,000 kw., and additional equipment will advance this to 180,000 kw. The following contracts have been awarded:

Steam turbine-generator unit, 60,000 kw., to General Electric Co. at $912,126; high-pressure boiler award, Babcock & Wilcox Co., $711,719; condenser, with auxiliary equipment, Foster-Wheeler Corp., $114,500; piping and accessories for turbine and boiler units, Grinnell Co., Providence, R. I., $145,992; three main transformers and auxiliaries, Moloney Electric Co., $127,710; two oil circuit breakers for station switchyard, Westinghouse Electric & Manufacturing Co., $54,800; two boiler feed pumps with auxiliary equipment, Ingersoll-Rand Co., $45,974; Westinghouse will also furnish closed feedwater heaters and evaporators, $32,468; American Blower Co. forced and induced draft fans, $29,780; Lock Joint Pipe Co., East Orange, N. J., pressure reinforced-concrete pipe installation for water supply, $57,871.

•

Allis-Chalmers Net Lower for Quarter

Net profit of Allis-Chalmers Manufacturing Co. for the quarter ended March 31 was $596,469, equivalent to 33 cents a common share. This compares with net of $969,869, or 54 cents a share, in the same quarter last year.

Unfilled orders on March 31 totaled $72,372,294, as against $21,313,400 a year ago and with $59,755,289 at the end of 1940.

Billings for the first quarter this year totaled $20,273,380, against $18,571,154 in the March, 1940, quarter.

The shrinkage in net income in the current quarter, the company said, resulted from the strike at the West Allis Works, which lasted 76 days and resulted in a very large unabsorbed burden.

•

G. E. Wage Increase

Factory workers in the major plants of General Electric Co. will receive an increase of 10 cents an hour, retroactive to April 7, as a result of an agreement reached with the United Electric, Radio and Machine Workers of America (CIO). The increase will affect between 75,000 and 80,000 workers.

Issue 1st Quarter Profit Statements

Babcock & Wilcox Co. and wholly owned subsidiaries in report for quarter ended March 31, 1941, show net profit of $1,221,300 after depreciation, interest, federal income taxes, excess profits taxes of $805,700, etc. This is equal to $1.82 a share on 671,970 shares of capital stock and compares with $829,565, or $1.23 a share, in March quarter of previous year.

The company's equity in profits, less losses, of companies more than 50 per cent owned but not wholly owned, less dividends declared, amounted to $184,717 in March quarter of this year, against $152,838 in like period of preceding year.

Other companies reporting first quarter earnings follow:

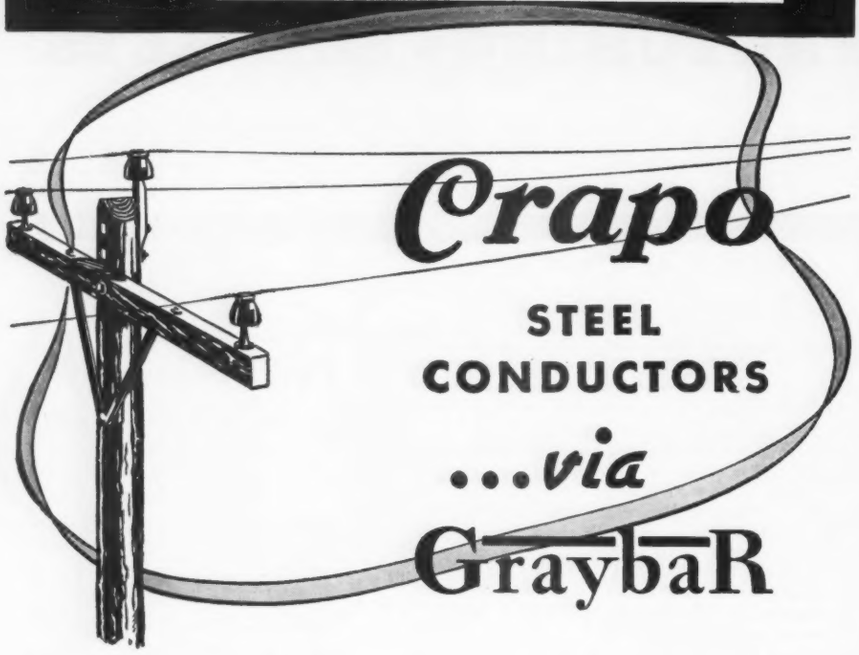
ELECTRIC STORAGE BATTERY—Orders received for first quarter compared favorably with the same period last year and shipments are higher, R. C. Norberg, president, stated at the recent annual meeting. The backlog on April 1 was well above the same date last year, reflecting defense activities. The company, according to Mr. Norberg, will more than earn the first-quarter dividend of 50 cents a share paid recently.

WESTON ELECTRICAL INSTRUMENT—Shipments in first quarter were above $2,000,000, compared with sales of $6,089,467 in the whole of 1940, Edward F. Weston, president, stated at the recent annual meeting. Sales in January and February this year were $1,400,000, and net profit on these sales after normal income taxes and estimated excess profits taxes were $179,889.

HYGRADE SYLVANIA—Net income after all charges and taxes, $283,220, equivalent to $1.18 a share on the common stock after the preferred dividend requirement. Provision for federal income and excess profits taxes has been set up for this first quarter at increased rates in anticipation of an upward revision of federal taxes this year.

MINNEAPOLIS-HONEYWELL REGULATOR—Net income, excluding operations of English and Swedish subsidiaries, $554,124, compared with consolidated net income of $294,704 last year. Net sales, $3,878,061, against $2,772,203.

FOLLOW THESE LINES FOR OVERHEAD SAVINGS



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When you're out for *high efficiency* at *low cost*, that's the time to come to GRAYBAR for *Crapo* Steel Conductors. An unusual combination of high tensile strength and electrical conductivity cuts maintenance costs "to the bone." Then, too, red tape and annoying delays are kept to a minimum when you deal "via GRAYBAR." For economy and efficiency all along the line, for steel conductors or other pole-line needs, call on GRAYBAR.

Crapo HTC-130 Stranded (3-wire) Steel Conductors . . . Available in Nos. 4, 6 and 8 B.W.G. Stranded (3-wire). Permit longer spans with greater ground clearances, decrease service interruptions. Particularly suited to branch primary circuits supplying farm and residential service. Write GRAYBAR today for 10-page booklet containing engineering data on electrical and physical properties. Ask for Bulletin 107.

Crapo HTC Galvanized Steel Conductors . . . Ideal for rural distribution systems where individual load units are small and distances covered are relatively great. Quickly and easily installed. Bulletin 105, which gives the story from beginning to end, is yours for the asking. Write for your copy today.

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Shipments of Oil Business Show Gain in February

Shipments of oil burners in February totaled 16,091 as reported by 159 manufacturers to the Department of Commerce. This compares with shipments of 11,522 a year ago as reported by 170 manufacturers. January shipments totaled 16,203, against 12,963 in January, 1940.

New orders in February totaled 16,328, against 18,513 in January and 11,239 in February, 1940. Unfilled orders at the end of the month totaled 10,590, against 10,353 in January and 2,767 in February, 1940.

•

Westinghouse Wage Pact

Westinghouse Electric & Manufacturing Co. has reached an agreement with the United Electrical, Radio and Machine Workers' Union (CIO) on a proposed wage increase, equivalent to a minimum of $4 weekly, for 45,000 workers in 24 plants. The increase was agreed upon at a conference in New York after months of negotiations.

An agreement for wage increases of $18 a month for salaried union employees has been reached with the CIO union.

•

Cutler-Hammer Warehouse

Cutler-Hammer, Inc., announces the establishment of a warehouse at 131 Clarendon St., Boston, Mass. To obtain the utmost efficiency in the operation of the new warehouse, the company's Boston sales office has been moved to new and larger quarters adjoining the warehouse.

•

Announces Wage Increase

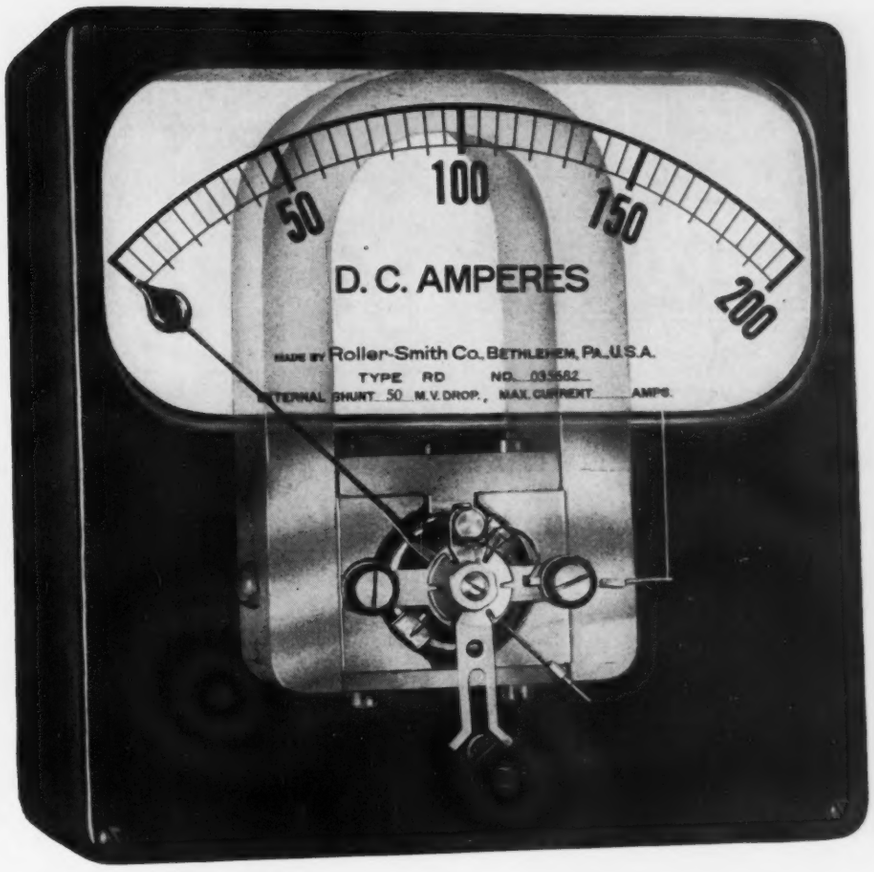
A general wage increase of approximately 7½ per cent, applying to all hourly workers and effective as of April 21, has been announced by the Hygrade Sylvania Corp., Salem, Mass. About 4,000 employees in the company's six Massachusetts and Pennsylvania plants will be affected by the increase.

New York Metal Prices

	April 29, '41 Cents per Pound	April 23, '41 Cents per Pound
Copper, electrolytic	12.00*	12.00*
Lead, A. S. & R. Price	5.85	5.85
Antimony	14.00	14.00
Nickel, Ingot	35.00	35.00
Zinc Spots	7.64	7.64
Tin, Straits	51.75	52.375
Aluminum, 99 per cent	17.00	17.00

* Delivery Connecticut Valley.

LOOK Behind the Dial



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—and you'll find this Roller-Smith D.C. switchboard ammeter a sturdily built, yet highly sensitive instrument.

Its design has been balanced to give best overall performance. The tungsten steel magnet is generously proportioned. The permanent magnet moving coil mechanism is effectively damped. Sturdy bridge construction assures accurate spacing and permanent calibration. The features found in the d-c ammeter are typical of the complete Roller-Smith line of a-c and d-c switchboard instruments. Get complete information today from our nearest representative or write Roller-Smith, Bethlehem, Pennsylvania.

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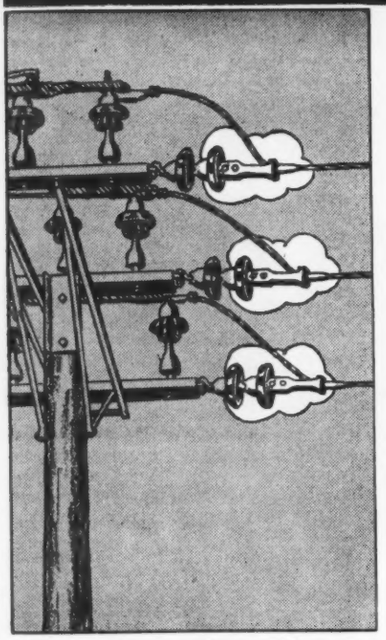

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•RELIABLE STRAIGHT-THRU DEAD ENDS with rigid clevis make convenient, low cost and high strength connections to disc insulators. The end of the wire can be fed STRAIGHT-THRU the unit and used as a jumper. Hole in clevis enables the lineman to insert bolt for attaching rope blocks when pulling slack. The dead end has the same design features as the Reliable Straight-line Splice.

Reliable
ELECTRIC COMPANY
OVER 30 YEARS SERVICE TO THE UTILITIES
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Field Reports on Business

The effects of strikes in industrial and defense plants is being felt in retail sales. While forward buying continues in good volume, there has been noted a slackening off. Utilities continue purchase of a variety of equipment as construction programs are speeded.

NEW YORK

Expansion of inventories is now being slowed up by delayed deliveries from suppliers. Strikes have delayed production in many plants. As new orders to manufacturers continue to rise, production schedules are being speeded to increase the rate of shipments. The volume of backlog of orders has reached such proportions in many plants that subcontracting is being pushed more so than in the past.

Work of the Price Control Administration is expected to be speeded to the point where control will be exercised over a large variety of commodities. Shortages in some lines is expected to force manufacturers of consumer goods to reduce production to release materials for defense production.

So far utilities have not been severely cramped on deliveries. Orders have been placed well in advance and no immediate pinch is expected. Plant expansion is going along on schedule and new generating capacity planned as needed.

A $1,100,000 power plant is to be built by the Atmospheric Nitrogen Corp. at Henderson, Ky. A $2,000,000 power plant has been started by Aluminum Ore Co. at Mobile, Ala. General Electric Co. has plans for a $50,000 addition to its plant on the East Orange-Bloomfield, N. J. line.

Utilities are ordering switchgear, transformers, capacitors, lightning arresters and instruments among other equipment.

Machine tool shipments for March are estimated at $57,400,000, against $29,000,000 a year ago. February shipments were $54,000,000.

Construction awards last week were $107,090,000, 62 per cent over the preceding week and 107 per cent ahead of a year ago.

PACIFIC COAST

Retail merchandising business, except during the usual Easter season spurt, has increased only slightly over last year. The major effort, so far, has been by wholesalers and manufacturers upon dealers who have bought heavily in anticipation both of heavy mid-year business and lengthened deliveries, but consumer buying is expected to set new records during latter May and then to continue all year.

California industrial developments include a $250,000 magnesium factory at Emeryville, a tripled capacity in a Niles steel plant and a $500,000 addition to the permanent magnesium plant at Sunnyvale. Pacific Coast firms are concerned over gradual withdrawal of intercoastal boat service through the Panama Canal and the governmental requisition of these boats for urgent Trans-Pacific service. This may presage transcontinental rail shipments, with consequently higher freight charges, and also greater strain upon, and consequently heavier purchasing by the railroads. Recent apparatus orders include three Westinghouse 12,000-kva. transformers, costing $53,298, for Tacoma; $51,577 for 230-kv. switchboard equipment for Grand Coulee; $278,000 G.E. miscellaneous equipment for service expansions at Bremerton navy yard; $192,283 for substations and transformers for Fort Lewis, near Tacoma, and two 230-kv., 600-amp. Westinghouse circuit breakers for Grand Coulee, costing $143,565. The outstanding bidding jobs cover a 30,000-kva. generator for Parker plant in Arizona and much heavy machinery for the Shoshone project in Wyoming.

NEW ENGLAND

Leveling off the previous strong upward trend in buying continues in this area and is attributed in some measure to a scarcity of equipment as a result of difficulty in procuring metals. Small motors and control apparatus are in demand, but sales have fallen off during the past month on account of lack of essential metals for their manufacture. Deliveries of motors have been lengthened in some cases to ten weeks; activity in selling supplies for revamping equipment in textile mills is reported and machine tool builders are receiving orders for small tools, gages and precision instruments in good volume.

Norwood (Mass.) Municipal Light Department is receiving bids for a 2,000-kva. substation. Electric furnace sales recently noted in New England include a 55-kw. heat-treating furnace for an eastern Massachusetts plant which plans further addition in the near future, and a $4,600 order to the Stanley P. Rockwell Co., Inc., Hartford, Conn.

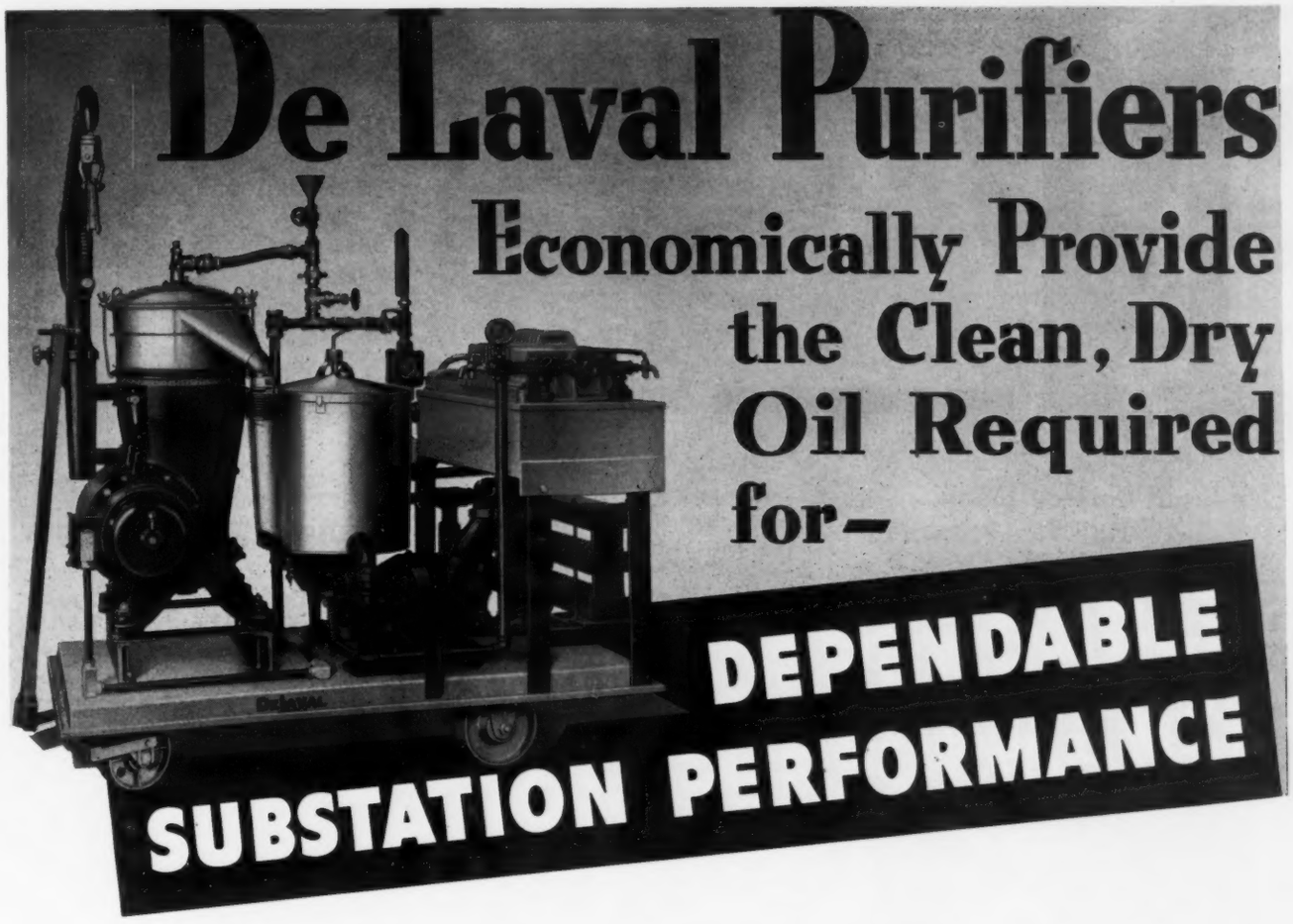
Collyer Insulated Wire Co. has been awarded a contract for electric cable amounting to $14,596. Sharply rising payrolls and a continuance of steady employment are stimulating residential building and an interest in electrical appliances. Retail trade in New England increased 15 per cent last week as compared with 1940.

CHICAGO

Industrial activity gained further momentum last week, primarily through distribution of defense orders and sub-contracts. Employment and payrolls made further gains during April and several instances of a shortage of skilled labor were reported. Jobs were up 18 per cent and wages 30 per cent over a year ago. Retail trade shows an average increase of approximately 16 per cent over the same period last year and dealers report an excellent demand for electrical appliances.

Investment in industrial plant expansion during the past 30 days amounts to $16,415,000, an increase of 450 per cent over last year for the same period. Chicago Transformer Co. will build an addition to cost $75,000 and Tuttle and Kift, Inc., will spend $120,000 for additional facilities to meet the demand for electric range parts. Plans have been made to install new lighting equipment in the Loop district, with a trial installation to be made in one block next week increasing the wattage from 3,500 to 12,000.

Defense orders placed in this area last week included electric equipment as follows: Wire and cable, $32,450; switchboards, $60,445; transformers, $111,610; portable drills, $61,485; electric trucks, $104,940; oil switches, $15,459; circuit breakers, $17,520; electric furnaces, $162,351; washing machines, $53,236; conduit, $69,123.



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The higher purifying efficiency and higher daily capacity of De Laval Insulating Oil Purifiers are two reasons why they are used by most of America's largest power systems.

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NEWS ABOUT PEOPLE

Indiana Service Elects Hill Vice-President

J. Calvin Hill, assistant secretary of the Indiana Service Corp., Fort Wayne, Ind., has been named a vice-president of that utility, and L. Kenneth Kimmel, now assistant treasurer, was elected treasurer.

Both Mr. Hill and Mr. Kimmel have

J. C. Hill

had considerable experience in the electric public utility and transportation field and have been associated with the corporation for a number of years in executive capacities.

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▶ HARRY TECKLENBERG, superintendent of Puget Sound Power & Light Co.'s northern division, with headquarters at Everett, Wash., has resigned to join the engineering staff of the Boeing Aircraft Co. He will supervise electrical production.

▶ WILLIAM SPRARAGEN, technical secretary and editor, American Welding Society, New York, N. Y., has been awarded the Samuel Wylie Miller Medal of the society for 1940, "for his work on the welding research committee, as editor of the *Welding Journal* and his part in promoting the ideals and work of the American Welding Society." He is president of the Sprargen Engineering Corp., New York.

▶ JAMES T. DEPPE, formerly in charge of lighting sales and dealer co-ordinator for the Central Arizona Light & Power Corp., has been appointed new residential sales manager. Mr. Deppe has been associated with the Arizona utility since 1937.

▶ W. A. PERRY, superintendent, electrical and power departments, Inland Steel Co., East Chicago, Ind., has been elected president of the Association of Iron and Steel Engineers for the coming year. Mr. Perry has been identified with the Inland Steel Co. since 1910.

▶ LOUIS J. NEVRAUMONT has been appointed chief of the Pacific Gas & Electric Co. personnel department, succeeding the late Harry C. Ross. A graduate electrical engineer, he began his utility career in 1915 as a brush tender in a San Francisco power plant. After various operating positions, he was made assistant manager of the Stockton division of Pacific Gas & Electric in 1926. In 1930 he became manager of the Modesto district, a position he held until his latest promotion.

▶ HAROLD F. FALK has been appointed general superintendent of the Falk Corp., Milwaukee, Wis. Upon receiving his degree from the school of engineering at the University of Wisconsin, Mr. Falk became associated with the Falk Corp. and rose to the position of superintendent of the welding department, where he remained until 1936. After devoting his attention to time study and special work in the shop and engineering departments, he was placed in charge of shop production and schedules in 1937, working in that capacity until 1940, when he was appointed production manager.

Seattle Utility Assigns New Duties to Walsh

Transfer of Frank Walsh as division manager of the northwest Washington area to manager of the central division, with headquarters in Seattle, Wash., and the assignment of Charles F. Terrell to full-time duties as operating manager of the company's entire system have been announced by Frank McLaughlin, president of Puget Sound Power & Light Co.

Since last November Mr. Terrell has been acting as manager of the company's central division besides serving as operating manager. He rejoined Puget Power after an absence of fifteen years, during which time he was associated with the light and power industry in Texas and Florida.

Mr. Walsh moves to Seattle from

Frank Walsh

Bellingham. He started with the company in Bellingham in 1912. In the interim he has been Puget Power's superintendent of light and power in Wenatchee and superintendent of the company's property in Everett. He took over the northern division in June, 1936.

President McLaughlin explained the

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assignments as being part of the company's program of bolstering service for the benefit of national defense.

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Faraday Medal Awarded to Dr. A.P.M. Fleming

The council of the British Institution of Electrical Engineers has made the nineteenth award of the Faraday Medal to Dr. A. P. M. Fleming, a past-president of the institution and director of research and education of the Metropolitan-Vickers Electrical Co., Ltd., Manchester, England. Dr. Fleming is well known in engineering circles in the United States, having been a frequent visitor to this country. He spent two years, from 1900 to 1902, at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Co. In 1915 he was sent here by the British government to make an investigation of American institutions organized to conduct industrial research. In 1921 he visited electrical manufacturing establishments here and again in 1938 made an extensive tour of the United States and western Canada. Dr. Fleming is a member of the A.I.E.E.

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▶ HAROLD F. DUNCAN was elected treasurer of Underwriters' Laboratories, Inc., at the recent annual meeting in Chicago. Mr. Duncan joined the Laboratories' staff in 1921 following military service in the World War. He served as assistant to L. B. Headen, who retired as treasurer last December. The following month Mr. Duncan was made acting treasurer.

▶ HAROLD W. SOPER has been made vice-president of the Ottawa Light, Heat & Power Co., Ltd., to succeed T. F. Ahearn.

▶ AUBREY KNOWLES has been appointed Missoula division manager for the Montana Power Co. Mr. Knowles was born in London, England, went to Montana in 1910, has been in the power business for 30 years, joining the Montana Power Co. on its organization in 1912. Prior to 1910 he was associated with electrical companies in Canada, Idaho, Washington, California, Pennsylvania and in the West Indies.

▶ COL. ARTHUR WALSH, military aide to Gov. Charles Edison of New Jersey and for many years an official of Thomas A. Edison Industries, Inc., West Orange, has been elected president of six subsidiary companies of the corporation. He will assume also the duties of chairman of the board of Thomas A. Edison Industries, Inc., although the office itself will be abolished. Colonel Walsh will succeed CHARLES S. WILLIAMS, who has retired. The changes were announced by Governor Edison, who is president of Thomas A. Edison Industries, Inc., but on leave of absence while Governor. He said Colonel Walsh would retain his position as executive vice-president of Thomas A. Edison Industries, Inc., in addition to becoming president of the subsidiary companies. Mr. Williams had been connected with the electrical products firm for 28 years.

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C. E. Brown, Jr., Elected Okonite Vice-President

Charles E. Brown, Jr., formerly assistant to the president, has been elected vice-president of the Okonite

Co. and the Okonite-Callender Cable Co. Mr. Brown, who has been associated with the company's sales department since 1925, will remain in charge of the Washington, D. C., office.

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▶ J. H. FISHER, manager of the middle Atlantic district of the Westinghouse Electric Supply Co. in Philadelphia, has been appointed manager of the company's northwest district with headquarters in Chicago. In Chicago Mr. Fisher will take over the duties of J. C. Schmidtbauer, who has been elected a vice-president of the company.

▶ D. S. MIX has been assigned the responsibility for media and publishers relations, General Electric publicity department, Schenectady. Mr. Mix will have responsibility for the work formerly handled by the late F. R. Davis. Mr. Mix was graduated from the Sheffield Scientific School of Yale University in 1917, joining General Electric immediately thereafter on editorial work in the publicity department.

▶ B. C. BOWE has been appointed manager of department store sales, accord-

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Look at these Headings

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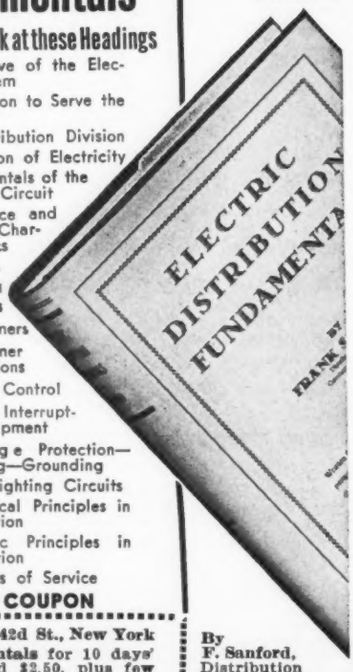
- Distribution to Serve the Load
- The Distribution Division
- Generation of Electricity
- Fundamentals of the Electric Circuit
- Inductance and Related Characteristics
- Tools for Electrical Problems
- Transformers
- Transformer Connections
- Voltage Control
- Current Interrupting Equipment
- Voltage Protection—Lightning—Grounding
- Street Lighting Circuits
- Mechanical Principles in Distribution
- Economic Principles in Distribution
- Measures of Service



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15 tables
1 chart

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ing to an announcement by C. M. Snyder, assistant manager of the General Electric appliance and merchandise department, Bridgeport, Conn. Mr. Bowe has had more than 11 years of experience in contacting department and furniture stores. He has been manager of appliance sales for General Electric in the St. Louis territory since 1938.

▶ JOHN S. BAILY, formerly with the Hood River, Ore., office of the Pacific Power & Light Co., has been named manager in Goldendale, Wash. Mr. Baily succeeds JOHN NATH, who resigned to enter the army.

▶ RAYMOND R. RIDGWAY, the Norton Co., Chippawa, Ont., Canada, has been elected president of the Electrochemical Society. Mr. Ridgway is one of the outstanding research men in electrothermics.

OBITUARY

Dr. Morton G. Lloyd

Dr. Morton G. Lloyd, distinguished engineer and chief of the safety codes section at the National Bureau of Standards since 1917, died April 26 at his home in Chevy Chase, Md., after a short illness.

During his professional career Dr. Lloyd made special investigations of the effects of self-induction and capacity in alternating-current circuits; effects of wave form upon induction meters, core loss and ratio of transformers and hysteresis; magnetic hysteresis in rotary field; regulation of public utilities, accident prevention and lightning.

Dr. Lloyd was an instructor in physics at the University of Pennsylvania from 1899 to 1902. From the latter year to 1910 he had served as laboratory assistant, assistant physicist and associate physicist at the Bureau of Standards. He was technical editor of the *Electrical*

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Review and Western Electrician, from 1910 to 1916.

He had taken a prominent part in many national associations. He was a fellow of the American Institute of Electrical Engineers, president of the International Association of Electrical Inspectors, a member of the U. S. National Committee of the International Commission on Illumination, past-president of the American Society of Safety Engineers, a member of the National Fire Protection Association, National Safety Council and of the American Standards Association.

Dr. Lloyd was a frequent contributor to the technical press and was the recipient of the Edward Longstreth medal of the Franklin Institute, 1910.

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▶ DAVID V. CARRUTH, president of the Public Electric Light Co., St. Albans, Vt., died on April 20, at the age of 71.

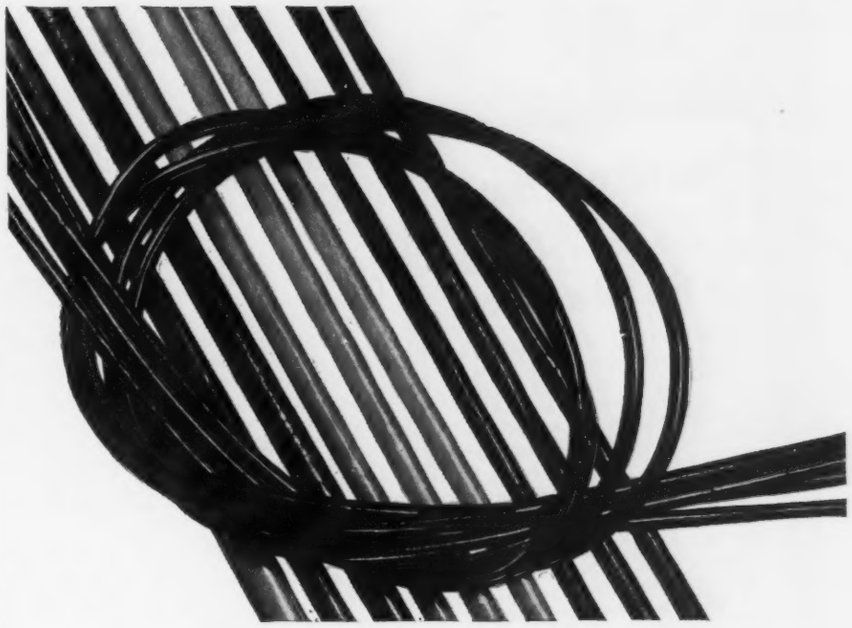
▶ WILLIAM J. STANTON, for 40 years purchasing agent of the Kellogg Switchboard & Supply Co., died February 24 at his home in Chicago, at the age of 64.

▶ REUBEN I. WRIGHT, retired chief engineer of the Electric Controller & Manufacturing Co., Cleveland, Ohio, died January 4. Mr. Wright was born at Sedalia, Mo., in 1876. He joined Electric Controller in 1900, serving successively as draftsman, chief draftsman, assistant engineer, sales engineer, engineer and eventually chief engineer and a director. He retired in 1920.

▶ ALFRED S. KELLOGG, 74, former president of the Engineering Societies of New England, for many years a prominent Boston engineer specializing in heating, ventilating and power plant work, and a past-chairman of the Boston section A.S.M.E., died at the Cambridge (Mass.) Hospital on April 16, from a heart attack. He had been in poor health for some time.

▶ ROSCOE SCHAEFFER, superintendent of engineering for the Oklahoma Gas & Electric Co., died at his home in Oklahoma City on April 18, following an illness of two months. Mr. Schaeffer had been connected with Oklahoma Gas & Electric since 1923. He was vice-chairman of the Oklahoma City section of the American Institute of Electrical Engineers. Mr. Schaeffer was a native of Illinois and a graduate of the Iowa State College. He was 49 years old.

▶ JOHN N. BROOKS, vice-president of the Torrington Electric Light Co., Torrington, Conn., died on April 7, of a heart ailment, at his farm in Goshen, Conn. He was 70 years of age. Mr. Brooks was active in varied fields, including banking, manufacturing and publishing.



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Sales Opportunities

LIVINGSTON, MONT.—Montana Power Co., Butte, has approved plans for new 50,000-volt transmission line from Livingston to Bozeman, Mont., close to 25 miles, and will proceed with work at once.

MOBILE, ALA.—Aluminum Ore Co., Mobile, has plans maturing for new steam-electric generating plant for service at local works, to be located on site fronting on Mobile River at Eastern extremity of company property. It will be equipped for initial capacity of about 7500-kw. Cost estimated over $1,500,000 with turbine-generator unit and accessories, high-pressure boiler and auxiliary equipment. J. G. White Engineering Corp., 80 Broad Street, New York, N. Y., is consulting engineer. Company is a subsidiary of Aluminum Co. of America, Inc., Gulf Building, Pittsburgh, Pa.

HAMILTON, OHIO—General Machinery Corp., Hamilton, plans installation of motors and controls, transformers and accessories, duct lines, switch-gear, fluorescent lighting system, conveyors, electric hoists, electric cranes and other equipment in new plant addition at local works of Hooven-Owens-Rentschler Company, manufacturer of engines, compressors, etc., a subsidiary interest; also, similar electrical equipment in parts of present plant, entire expansion to be used for production of propelling machinery for Navy Department, Washington, D. C. Cost estimated at $1,500,000, and fund in that amount will be secured through Government for project.

HAWARDEN, IOWA—City Council will have plans completed soon for addition to municipal power plant, to include installation of new 1000-kw. generating unit and auxiliary equipment. Cost estimated about $92,000. Buell & Winter Engineering Co., Insurance Exchange Building, Sioux City, Iowa, is consulting engineer.

DENVER, COLO.—Bureau of Reclamation, Denver, receives bids until May 26 for one 30,000-kva. electric generator, complete with thrust and upper and lower guide bearings, surface coolers, main exciter unit and pilot exciter; and for three outdoor-type transformers with accessories, three disconnecting switches and one lightning arrester, all for installation in Parker hydroelectric generating station, Parker Dam power project, Arizona-California (Specifications 961).

CROOKSVILLE, OHIO—Ohio Power Co., Newark, Ohio, has approved plans for new transmission line from Crooksville to Lancaster, Ohio, close to 30 miles, and will proceed with work at once.

CAMDEN, OHIO—Village Council has plans maturing for new municipal power plant and distribution system, including street-lighting system on Main Street. Proposed to use diesel engine-driven generators and auxiliaries. Bond issue of $110,000 has been authorized for project. Bids are scheduled to be asked soon. Carl J. Simon & Associates, Van Wert, Ohio, are consulting engineers.

CHARLESTON, S. C.—Pittsburgh Metallurgical Co., 3801 Highland Avenue, Niagara Falls, N. Y., manufacturer of ferro-silicon and other ferro-alloys, plans installation of motors and controls, switch-gear, electric furnaces and accessories, interior lighting system, regulators, conveyors, electric hoists and other equipment in new plant at Tuxbury, vicinity of Charleston, where tract of about 60 acres of land has been acquired. All plant equipment will be electrically-operated. Company has closed contract with South Carolina Public Service Authority, Charleston, for power supply from new hydroelectric power station near Moncks Corner, S. C., now being completed as part of Santee-Cooper project, and transmission line will be built to plant site, where power substation will be located. New plant will consist of several production units and is estimated to cost close to $1,000,000. Work is scheduled to begin soon.

RIVERTON, WYO.—Bureau of Reclamation, Denver, Colo., receives bids until May 14 for three 1667-kva., 60-cycle, single-phase, oil-immersed, self-cooled, 2300 to 39,838/69,000 Y-volt transformers; one 5000-volt, 2000-amp., triple-pole, indoor-type, oil circuit breaker; one 69,000-volt, 600-amp., triple-pole, manually gang-operated, outdoor-type, disconnecting switch; three 5000-volt, 2000-amp., single-pole, hook-stick-operated, indoor-type, disconnecting switches; three 69,000-volt, single-pole, station-type, lightning arresters, all for Shoshone power plant, Wyo. Also, at same time, for one 2500-kva., three-phase, oil-immersed, self-cooled, outdoor-type, iron core, shunt reactor; two 69,000-volt, 600-amp., triple-pole, manually gang-operated, disconnecting switches for Thermopolis power substation, Shoshone project. And, for three 667-kva., single-phase, 60-cycle, 2400 to 19,920/34,500 Y-volt, oil-immersed, self-cooled, outdoor-type transformers for Pilot Butte power plant, Riverton project. All equipment will be installed by Government (Specifications 1505-D).

WEST HENDERSON, KY.—Atmospheric Nitrogen Corp., a subsidiary of Allied Chemical & Dye Corp., 61 Broadway, New York, N. Y., plans early construction of new steam-electric power plant at new Ohio River Ordnance Plant, West Henderson, now in course of erection by Federal Government, with output to be used for power requirements at that works. Contract has been made with War Department, Washington, D. C., for power station, which will include turbine-generator units, high-pressure boilers and auxiliary equipment. Cost estimated at $1,100,000. Atmospheric company, noted, also is interested in ordnance plant mentioned, to be used for production of synthetic ammonia, and will operate that property under previous agreement with Government. Complete electrical equipment will be installed for all divisions of operation, entire project to cost about $15,500,000.

KLAMATH, ORE.—Bureau of Reclamation, Denver, Colo., receives bids until May 15 for 2300-volt motor-control equipment and accessories for pumping station "D," Modoc Unit, Tule Lake Division, Klamath project, Oregon-California. All equipment will be installed by Government (Specifications 1506-D).

SPOKANE, WASH.—Administrator, Bonneville Power Project, Department of Interior, Pittock Block, Portland, Ore., plans 230,000-volt transmission line from Grand Coulee hydro-electric power station, Grand Coulee, Wash., to vicinity of Spokane, about 76 miles, as part of 1941 line program, to be of similar type as line to be constructed from Grand Coulee to Bonneville. Cost estimated about $150,000. Appropriation has been arranged.

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Recent Legislation

Action has been taken recently on utility bills in various state legislatures:

CALIFORNIA—Assembly public utilities committee has tabled the Burns public utilities revenue bond act, which would permit public agencies to use revenue bonds to finance water or power projects. The Burns bill was similar to the Garrison revenue bond act which was stalled in the senate local government committee. Both measures would provide that revenue bonds could be approved by a majority vote of the people, instead of the two-thirds majority now required.

CONNECTICUT—Senate public utilities committee has voted to report favorably a bill providing for appointment of public utilities commissioners upon nomination of the Governor and confirmaton by the Senate. The present law requires confirmation of the governor's nomination by both branches of the state legislature. The committee at the same time voted to report unfavorably on a bill to have public utilities commissioners elected by the people. The new rural electrification bill has been favorably reported to the Senate. This legislation sponsored by the Public Utilities Commission provides that co-operative non-profit membership corporations may be organized to supply electric energy and promote and extend its use to persons in rural areas not receiving central station service.

FLORIDA—Measure introduced in the General Assembly by Representative Burke would give the State Railroad Commission jurisdiction over electric and gas rates in the state and require utility corporations to make "just and reasonable" charges for service. The commission would be authorized to ascertain the quality of service from time to time and order improvements. The bill specifically exempts from regulation plants and systems owned or operated by municipalities.

MARYLAND—Despite some opposition from the state Public Service Commission and the Maryland Utilities Association to rural legislation requested by the Federal REA, the legislation has been passed by the state Assembly. Fifteen amendments to the bill proposed by Clarence W. Miles, serving as counsel for the utilities association, were accepted by the senate finance committee. A delegation of REA attorneys from Washington, who were on hand, said they would not oppose a dozen of the changes, but the final three, they contended, would kill the bill entirely. Mr. Miles tried to cut out the REA bill's main provision—a clause saying that when more than half of the residents of a farm community vote to start an REA co-operative, there shall be no building of power lines in that community for six months. The public service commission rules on whether the REA shall operate, or whether the private utilities shall build the lines. Mr. Miles told the finance group that in many respects "this is a shocking piece of legislation." He said county and municipal governments were denied the right, under its terms, to regulate the placing of poles and power lines. He said it gave co-operatives the right of merger, which is denied private companies, and he contended also that damage suits in some instances would be denied those who might be injured by co-operative equipment.

NEBRASKA—The power tax bill, in the form in which it recently left committee, would provide that the property of the state and its governmental subdivisions shall be exempt from taxation. This was not new but served as a foundation for the following exception: "Provided that any real or personal property, together with any subsequent renewals, replacements, or additions thereto, shall not be or become exempt from taxation by reason of any prior or subsequent transfer of title or ownership to any public power district or public power and irrigation district, or any legal successor thereto; and provided further that any such property which is now or may be hereafter owned by any city or village shall be exempt from taxation." It is the purpose to tax districts for all properties removed from the tax rolls, also improvements to same. It also is the intention to tax municipal plants if and when they pass into the hands of public power districts. In event ownership returns to the municipality, exemption returns with it.

NEW MEXICO—Governor Miles has signed the utilities control bill. The bill proposes to set up a control commission composed of three members, appointed by the Governor. The agency would have power to establish "reasonable" rates after investigation and to regulate financing and servicing within limits. Municipally-owned utilities would be excepted, but might elect to come under the bill's provisions by local option.

NEW YORK—Bill extending for another year the 2 per cent tax on gross income of utility companies has become a law, as has also the measure authorizing the city of Plattsburgh, subject to approval of Public Service Commission, to purchase properties of the New York State Electric & Gas Corp. located within Clinton County and providing payment thereof from municipal electric plant construction fund. Bills in the hands of the Governor follow: Authorizing agent of municipal corporation operating utility to enter buildings supplied with electricity or gas for inspection of meters and includes buildings supplied with water by utility corporation; permitting corporations to make contributions for social and economic betterment for one year period beginning April 12, 1941, expenditures by utility corporations not to be part of expenses of operation; authorizing city boards in control of electric utility owned and operated by city to appropriate moneys derived from its operation for expenses of maintaining municipal electric utilities association of state, including its activities for obtaining greater economy and efficiency in operating utility; extending to July 1, 1941 the right of cities to impose 1 per cent tax on gross receipts of utilities.

OKLAHOMA—Legislation to speed rulings in public utility rate litigation by keeping such cases in state courts was advanced for final passage by the state House of Representatives recently. The bill will prevent utility companies from taking rate cases in Federal District Court. Chief feature of the measure is that the state supreme court shall make only a judicial review of the findings of the state corporation commission, reversing the case or remanding it to the commission for new hearings if it fails to agree with the findings.

WISCONSIN—Assembly has passed and sent to the Senate the bill which clarifies the 1939 statute setting up a 3 per cent state tax on the gross receipts of rural electrification co-operative associations in lieu of all other taxes. The Kennedy bill, which would increase the amount which the state retains from utility tax collections

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During the month of December 1940 the acceptance in the field of M.I.F. Guy Hooks for through-bolt guying construction passed the 1,000,000-mark. We feel this endorsement by Companies constituting more than one-half the operating capacity of the U. S. and Canada means more than what we say about them.

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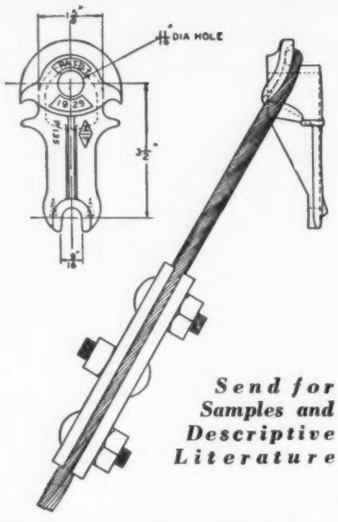

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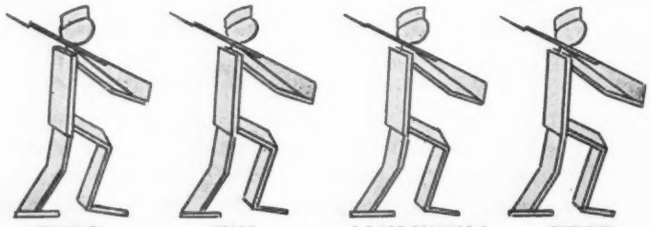

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and earmark the state's share for aid to elementary schools, has been introduced in the assembly. The Cook bill, which would place a tax of 3 per cent of gross receipts on all lines and associated equipment of private electric utilities used directly for furnishing energy to rural customers instead of the present method of basing the state tax on property value, has been introduced in the Assembly. The measure provides that the savings of the utilities from the proposed new method of taxation would be passed on to the rural customer under public service commission order, if a utility refused to take the action voluntarily.

•

Municipal Plants

AUDUBON, IOWA—City will hold an election on May 16 on the proposed municipal light and power plant estimated to cost $225,000. Buell & Winter Engineering Co., Sioux City, Iowa, are the engineers. Iowa Public Service Co. serves the city.

NORTH BALTIMORE, OHIO—State Supreme Court has granted the motion of the Central Ohio Light & Power Co. for a review of its suit against the village to prevent the construction of a municipal electric plant. The company lost the case in the lower courts. North Baltimore voters approved a $127,220 mortgage bond issue for the plant, but when the village council acted to issue and sell the bonds, the company petitioned for a second referendum, which Council refused. Lower courts upheld the council's action and ruled the bonds were not in violation of a law restraining competition with an existing private industry because the bonds were not to be paid by the taxpayers.

PARDEEVILLE, WIS.—State Supreme Court has reversed an order of Circuit Judge A. C. Hoppmann, upholding a price of $25,000 for municipal acquisition of the Pardeeville Electric Light Co. property fixed by the state Public Service Commission and ordered new proceedings by the commission to set a value as of the time of the commission's order. The decision was in line with previous high court rulings which have held that the commission must determine the just compensation as of the date of its order and not for any previous date.

COLUMBUS, KAN.—In a recent election citizens voted against the issuance of $240,000 in revenue bonds to build a municipal plant and distribution system by a vote of 682 against and 434 in favor of the proposition. Empire District Electric Co. serves the city. Agitation for this plant was started last fall and a bitter campaign was carried on. Under the Kansas law there would have been required a two-thirds majority in favor of the bond issue.

ADAMS, WIS.—Court action brought in Dane County Circuit Court against the Wisconsin Power & Light Co. by the city has been dismissed on motion of the city. The action had been started in an effort to secure opening of the acquisition proceedings, which terminated some months ago when the city failed to pay for the distribution system within the four-month time limit set by the state Public Service Commission. Under the terms of an agreement with the Wisconsin Power & Light Co., as a result of the dismissal of the court action, the utility will begin at once an improvement program of the distribution and street lighting system.

Carbon Dioxide Safeguards Hydro Generators

[*Continued from page 56*]

carbon dioxide installation. This installation, which consists of eight 50-lb. cylinders, is arranged to protect the following hazards:

1. Indoor transformers (nine).
2. Oil storage room.
3. Lubricating oil tanks.

The nine indoor transformers, which vary in rating from 10,000 kva. to 17,500 kva., are installed along one side of the main generator room and present a fire protection problem that lends itself perfectly to a "total-flooding" carbon dioxide system. Each transformer is isolated in an individual inclosure with three walls and ceiling of concrete and a front of plate steel panel construction. Doors are 4 ft. above the floor level and brick bulkheads of this height prevent oil overflow from running out of the inclosures.

The two types of transformers used at Holtwood meant that different methods of discharging the gas were required. On the newer gas cushion or conservator types six 50-lb. cylinders of carbon dioxide are discharged into the entire volume of the inclosure outside of the transformer itself. On the older type, which have air spaces above the oil, the contents of two gas cylinders are released into this air space inside the transformer tank. Control is manual because these transformers are under constant observation of the operating staff.

In addition to this gas protection, each transformer is equipped with a water ring placed about 4 ft. from the floor, with nozzles directed downward. This water spray is automatically discharged simultaneously with the gas discharge by means of a pressure-trip release on a carbon dioxide pipe-line. Our experience has shown that the combination of the flame-smothering gas and the cooling water-spray is highly effective on ground fires in these transformer inclosures.

At the floorman's desk are switches operating electric releases on distribution valves for all transformers (all electric releases may be operated manually). There, too, are switches to operate releases for oil rooms and tanks in case thermostats fail to function.

[*EDITOR'S NOTE—All photos by courtesy of Walter Kidde & Company, Inc.*]

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GROUND TESTER

As simple, rugged and reliable for ground resistance measurements as are our "Megger" instruments for testing insulation.

With ground resistance testing now a recognized necessity for protection against lightning and for safety to human life, we offer a "Megger" Ground Tester that has the desirable characteristics which that well-known name implies.

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FOR MEASURING RESISTANCE TO EARTH OF ALL TYPES OF ELECTRICAL GROUND CONNECTIONS.

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Light at any Angle

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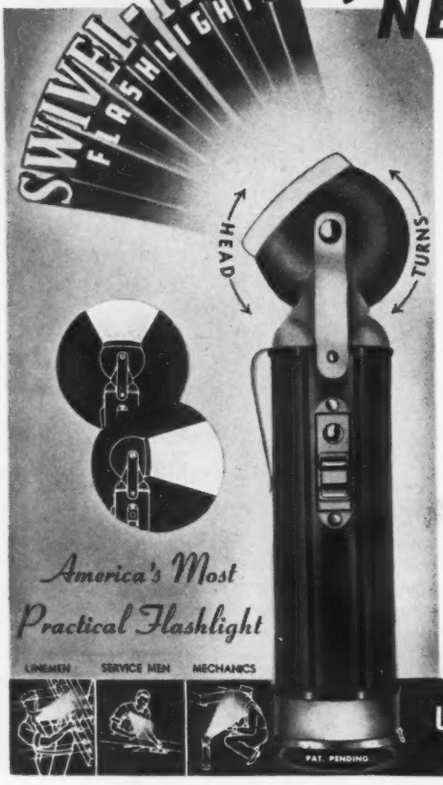

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INSULATION

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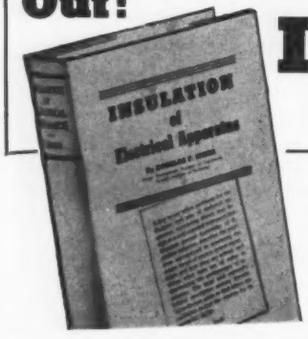

HERE is a new and helpful guide for all concerned with the design and use of electrical apparatus —a book that covers all aspects of its insulation— concisely reviews the theory—describes and compares the materials—and gives complete details of the insulation problems present in all types of electrical apparatus and how they are solved.

INSULATION OF ELECTRICAL APPARATUS

By Douglas F. Miner
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450 pages, 6 x 9, 306 illustrations, $5.00

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This book bridges the gap between the more theoretical treatments of dielectric phenomena and the needs of engineers and designers for data on present-day insulation practices.

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Modified Primary Network Solves Two Problems

[*Continued from page 59*]

character of the load in the area. Investigation showed that: (1) Regulating points for isolated phase areas were so widely separated that with encroachment of three-phase load in the isolated phase areas unequal primary voltages, and consequently load, resulted on certain three-phase main transformer banks, causing fuse operation. (2) Low voltage and poor regulation were encountered on the ends of certain single-phase laterals in isolated phase areas. (3) Steady encroachment of three-phase apartment house loads in single-phase areas made rearrangement of the existing arrangement desirable.

Solution Adopted

Solution adopted is shown in the accompanying "after" diagram. As indicated, three-phase main feeders were extended into the formerly isolated phase areas. Single-phase laterals were tapped off the principal three-phase mains throughout the area and these single phase laterals of like phase were "networked" to eliminate the poor voltage condition that formerly existed. Secondary runs from single-phase distribution transformers were banked extensively, according to past practice, and secondaries fused at the midpoint in accordance with the rule already stated.

No attempt was made to sectionalize the primary feeders or laterals. All primaries were connected together solidly. However, No. 6 primaries were used to network the single-phase laterals so that they would burn clear in the event of fault. It was considered unnecessary to tie neutrals of primary laterals together because of the recent adoption of the common neutral system now in use. In the event of a serious fault on the three-phase mains, the ties between single-phase laterals is expected to give the extra copper capacity necessary to feed current into the fault and help to burn it clear. With this arrangement there is expected to be no more trouble in clearing faults on this modified network than there was on the previous system.

The individual regulation of each isolated phase area was eliminated and regulators at the substation set to compensate to a common load cen-

ter located at a point near the first customer, as indicated. Compensators on regulators at the substation were set to hold the highest voltage at this point that the first customer could stand for nominal 115/230 volt service.

Where combination light and power service was required from three-phase banks the practice was adopted of going to a Y-Y transformer connection with secondary voltage of 115/119 volts, with boosting transformers to supply 230-volt, three-phase service when required.

Multimeter Test Unit Increases Efficiency

[*Continued from page* 52]

ter is conveniently placed on an inclined panel. All switching is done by toggle switches located in positions close to the fingers when the operator's arms are resting on the bench.

Two vertical drawers are provided, one on each side of the test panels. The drawer at the right is designed to hold necessary tools, and a hinged bracket for sealing tool and seals can be swung out when the drawer is partially open. The drawer at the left contains a light-weight air hose which recoils after being used.

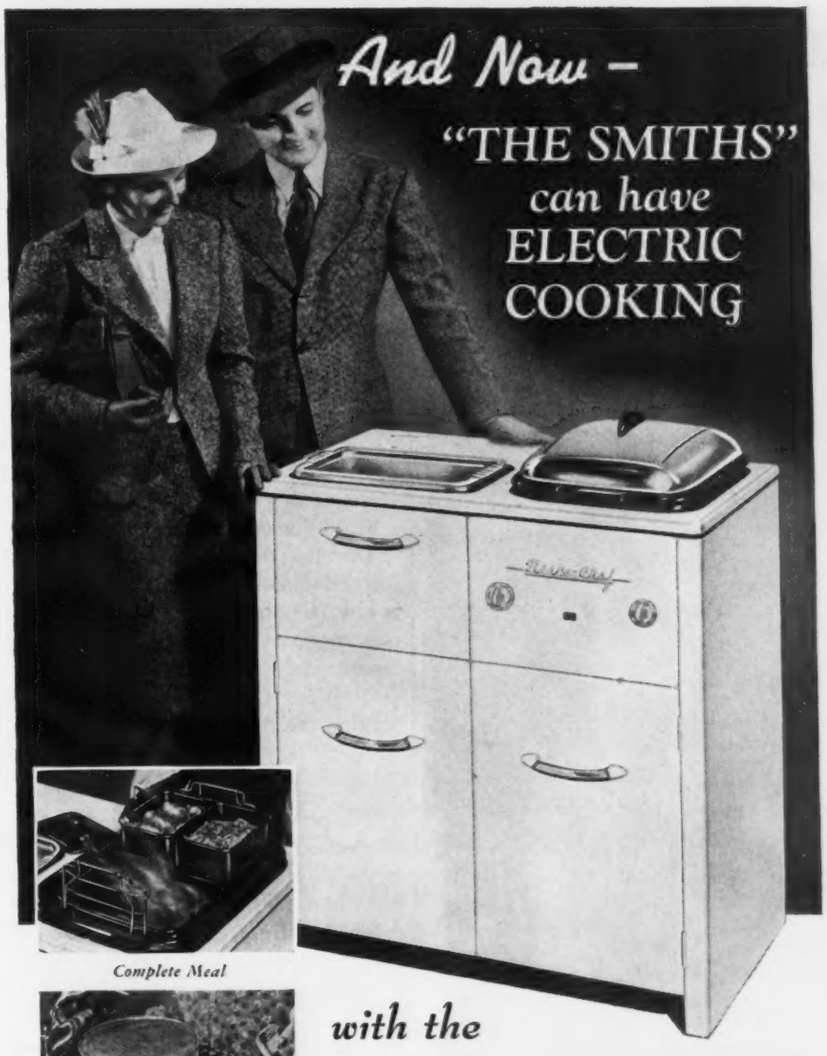
Little satisfaction would have been received from the introduction of the multimeter test unit had it not met with the approval of the men whose job it is to do the testing. From these men comes the opinion that the unit permits a high rate of production with less effort and fatigue than was formerly experienced in testing considerably fewer meters daily.

•

Engineering Department Maps Indiana Utilities

An electric utility map of Indiana as of January 1, 1941, has been completed by the state Engineering Department. In tracing form, from which blueprints can be made, the 42 x 72-in. map may be secured from the H. Lieber Co., Indianapolis, Ind., at $1.25 a copy, plus postage.

For free distribution the department has had printed a limited number of maps 21 x 36 in. which may be obtained from the Engineering Department, Public Service Commission, State of Indiana, Indianapolis, Ind.



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NESCO CHEF

Complete low cost electric cooking now comes to the average family. This new appliance—the NESCO CHEF, operates on 110-115 volts and combines the best features of an electric roaster, a broiler, and a surface unit. It requires no additional distribution system and transformer equipment to meet customer requirements.

ANNUAL NET RETURN $12.31*

Ideal as a load builder, daily use of the NESCO CHEF turns the minimum bill customer into a profitable consumer at higher domestic daylight rates. **Actual home use of 300 test units by a prominent eastern utility showed an average use of 708 Kwh. annually with a net return before sales expense and income tax of $12.31!* Let us give you complete details of this test. . . . Write or wire today.

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FOR THE MAN WHO KNOWS PLIERS

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ASK the old timer who has been up on the sticks since the turn of the century. Ask the grunt who wants to be up there, too. Ask any lineman or electrician anywhere—he'll tell you that only one kind of plier is good enough for him—the kind that carries the Klein trademark. Such universal recognition of quality by men who know is what has made the name Klein first in electricians' tools "since 1857."

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Foreign Distributor:
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Range, Water Heater Sales Pace Competition

[*Continued from page* 53]

was based upon $10 plus 20 cents per foot of cable from the service loop to the switch located in the basement. The cost of these jobs averaged approximately $15 each. Due to the fact that the company, for a number of years, has required that no new entrances be less than three No. 6, only one-half the sales required outside wiring, making the subsidy amount to less than $8 per range sold. Fifteen percent of the 1940 sales were for ranges selling for less than $100 installed, for which the company gave a $12.50 dealer bonus.

Our list shows approximately 430 electrical dealers in this territory; about 160 of these took advantage of our entrance wiring allowance. We could safely say then that there were 400 all-electric customers per dealer serving the rural area.

Water Heaters

The present plan for the promotion of electric water heaters was initiated in 1934, and at that time there were less than 600 water heaters on the company's lines. The combination of the 1½-cent step in the residence rate, installation allowance of $13 for factory-built water heaters, plus an offer to install electric conversion water heaters for $1 per month on a rental-purchase plan, stimulated sales to the extent that there were sold in seven years more than 6,000 water heaters (2,150 factory-built water heaters and 4,000 conversion water heaters).

Whereas in 1934 only 19 percent of total sales were factory built, in 1940 this figure rose to 50 percent. The raising of the percentage of the factory-built water heaters required very careful negotiation on the part of company salesmen for fear that the customer might become confused over conflicting claims and decide not to put in either type of heater.

Conversion Heaters

The conversion water heater was a product of the depression years* and required the enthusiastic support of the management of the company. This is well illustrated by the fact that other companies have attempted the conversion water heating activity but with less pronounced success. The

*See "Electrical World," June 19, 1937, page 36, "The Conversion Heater as a Steppingstone."

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THOUSANDS of patterns — you can find the exact lug you want.

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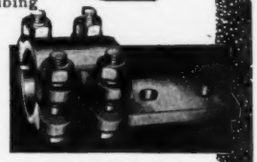

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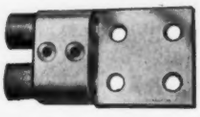

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Also the most complete line of Cable Taps, Service Connectors, Ground Clamps, Two-Ways, Tees, etc.

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PENN-UNION
Conductor Fittings

sales price at present is $45 gross, $38.40 net for a 30- or 40-gal. installation ($10 added for second element and thermostat when required; higher price for larger installations), to be paid for at $1 per month.

The customer is allowed a 20 percent discount for cash on the balance remaining after the first twelve payments have been made. This has stimulated the payments to the extent that 25 percent of the contracts are paid up within a year. Eighty-five percent of the jobs are 1 kw. capacity. The average consumption is approximately 300 kw.-hr. per month, which means that the monthly load factor will run as high as 40 percent.

Two-tank

In order to gain public acceptance by reasonable operating expense, two-tank installations are encouraged to secure the benefits of tempering in the uninsulated tank during summer months and moderate preheating in the winter months when extremely cold inlet water prevails. This also results in more advantageous location of the water heater near the point of most frequent use (generally immediately under the kitchen). The rental-purchase plan provides that the company finance the cost of a new range boiler when required up to an installed price of $20, increasing the total monthly payments to $1.50. Due to relatively favorable water supply and the low heat density of the strap-on heating unit, galvanized tanks have been found to give satisfaction both from the standpoint of customer cost and company's service complaints. No service troubles of consequence have developed with the 4,000 heaters in operation.

Reverts from all causes during the last seven years amount to 640 jobs, the majority of which is due to the customer's moving out of the area and the inability of the salesman to sell the incoming tenant. It is believed that 12 percent saturation is a new record for electric water heater sales under existing climatic temperatures and a 1½-cent rate.

•

Orders New Boiler

Combustion Engineering Co. has received a contract from Interstate Power Co., Dubuque, Iowa, for a high-pressure boiler unit and accessories for installation in the local generating station.

LET'S PLUG IT IN

...Speedily!

Throwing the production capacity of this country into full swing—putting the country's mighty resources to work—PLUGGING IN the industrial machinery of the USA—that is today's big job.

It is a job that must be tackled with determination by every branch of the electrical industry.

To aid National Defense, Roebling has "plugged in" its facilities. Roebling plants are operating day and night—at full capacity.

Equally important, Roebling is unceasingly maintaining the high standard of quality for which Roebling electrical wires and cables are noted—a standard of quality that is a safeguard against shutdowns and delays, that assures all-around dependable service.

JOHN A. ROEBLING'S SONS COMPANY

TRENTON, NEW JERSEY

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WIRES AND CABLES

Remember the BIG fire?

EVERY town has *one* big fire to remember.

Ours was in Baltimore, spring of '06. The whole business district was in flames. Appeals were sent out to cities over a hundred miles off.

Six fire companies from New York arrived . . . rolled their equipment off flat cars and went screaming into action. . . .

But not *one* of New York's engines could be connected to a Baltimore hydrant! The suction hose threads were different.

Since that time members of the American Fire Service and other organizations have labored endlessly to standardize hose threads and other fire fighting equipment—so that prompt mutual aid between communities would be possible.

Men working together . . . it brought us greater protection, economy, new efficiency—in our own electrical industry, too.

Maybe you recall when the multitude of lamp bases were changed to the Edison base—receptacles and plugs were standardized — utility equipment was built to uniform specifications.

Markets expanded, prices dropped, *everybody* gained in more business and greater comfort!

Men working together did it . . . associations like A.I.E.E., N.E.M.A., E.E.I. and a host of others.

★

ELECTRICAL WORLD believes that *no one* should minimize the multitude of benefits that have accrued from association activities in the electrical industry. Nor should this vital activity be in any way curtailed. That is why the editors plan to devote the issue just preceding the annual convention of Edison Electrical Institute to

ASSOCIATION FOR SERVICE

We will point out the achievements of electrical associations, outline the work in progress, discuss future plans. It will be presented in brief, readable form, with plenty of illustration and editorial cartoons, telling a dramatic story in picture form.

We believe that you should watch for this issue and plan to use it to protect the interests of your own voluntary organizations. We *know* you will be interested in it.

The date, May 31st. The issue "ASSOCIATION FOR SERVICE." The editors of ELECTRICAL WORLD are proud to present this contribution toward the continuation of *men working together.*

PAGE FENCE

America's First Wire Fence — Since 1883

PROTECTION—ON THE LINE

★ The name PAGE not only identifies dependable property line protection but it is the symbol of quality that safeguards the investment. In Page Fence you get an assemblage of superior qualities, many of them exclusive. Page Winged Channel Posts are stronger and longer lasting. Page Fence fabric of copper-bearing steel wire is heavily galvanized after weaving. All parts of the supporting structure are expertly designed and faultlessly made. And Page Fence is erected by technically-trained, long-experienced, responsible local business men. Write for "Fence Facts," to PAGE FENCE ASSOCIATION, Monessen, Pa., or Bridgeport, Conn., New York, Pittsburgh, Atlanta, Chicago, San Francisco.

A PRODUCT OF PAGE STEEL & WIRE DIVISION—AMERICAN CHAIN & CABLE COMPANY, INC.

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FUSES and KLIPLOKS

Eliminate unnecessary shutdowns caused by fuses faulty in design — and bad clips. Safe, efficient and dependable protection automatically predominates when you install this famous TRICO COMBINATION.

TRY TRICO!

WRITE

TRICO FUSE MFG. CO.

MILWAUKEE, WIS.
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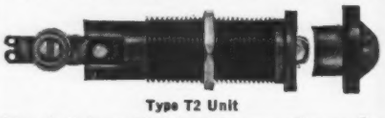
NEW ALL-PLASTIC SWITCHBOARD LAMP

FOR SINGLE HOLE PANEL MOUNTING



Type T2 Unit

The shell is molded in the same color as the lens-cap to prevent error in replacement . . . furnished with a 24 volt slide-base lamp, (.038 amp.) . . . used with a series resistor assembly for operation on voltages up to 440 . . . five different colors . . . brilliant 180 degree visibility . . . low in cost.

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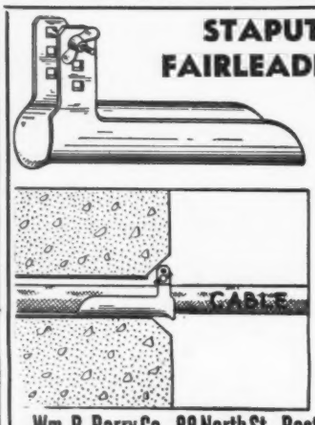


Save Your Cables

Prevent Abrasion at the Duct Mouth

•

Low Cost Installation

Wm. B. Berry Co., 88 North St., Boston, Mass.

Regulator Settings Improve Circuit Voltage

[*Continued from page 61*]

ers to be evenly spaced along the circuit and assuming an average additional drop of 5 volts from primary to service entrance between no load and full load, the area under each curve may be taken as a measure of the value of each arrangement with regard to regulation. The arrangement having the smallest area under the curve would give the minimum average variation to the customer.

Similar in Result

The two different regulator connections, used with unequal compensation settings, provide practically the same regulation. The difference is slightly in favor of the standard connection, which is preferable in any case because of its other advantages. It should be noted, however, that one of the regulators in the standard connection must have enough capacity to boost 12 per cent, while the largest boost necessary with the cross-connection is about 8 per cent. A maximum boost of not over 10 per cent would be required ordinarily except on circuits where the regulation is unreasonably poor, as in the circuit assumed here, or where a considerable portion of the regulator range is used to correct bus regulation.

Since the settings for the various arrangements have been made to give minimum voltage regulation without regard to voltage level, it has been necessary in the sample case to sacrifice a certain amount of regulation in order to improve the voltage level with capacitors. On most circuits without capacitors it is necessary to use a fairly high contact-making voltmeter setting and a reduced amount of compensation in order to keep the voltage level at a reasonable value. In these cases use of capacitors permits a lower contact-making voltmeter setting, more compensation and a resultant improvement in regulation.

It will be seen from the tables that the standard regulator connection gives better average results where capacitors are used than the cross-connection.

Although the various arrangements shown are but a few of the many possible combinations of capacitors, regulator connections and regulator settings which can be made, they show

how two regulators can be set to regulate to two different load centers accurately, and to a third with fair accuracy. The same method of analysis can be applied to any circuit where balanced three-phase voltages are not required.

Adds 25,000 Kva. in Five Months

[*Continued from page* 63]

In a period of four months and 22 days from the first work started the design of foundation, steel structure, piping and electrical work had been finished and construction had progressed to such a point that the generator was put on the line, all work having been completed except floor finish and pipe insulation.

Close co-ordination of work of the various contractors made this schedule possible, with little delay at any time. The heat cycle is conventional. The engineering was done by the local engineering force of the company and work was supervised by the same group of men.

Principal Equipment Added

Turbo-Generator—General Electric Company. One 20,000 kw. 1,800 r.p.m. turbine, 400 lb. pressure, 725 deg. total temperature. Extraction connections for 1st, 4th, 5th and 11th stages; one 25,000-kva., 14,000-volt generator, three phase.

Exciter and Pilot Exciter—General Electric, 250 volts direct connected, controlled by G.E. regulator.

Generator Air Cooler—General Electric Company. Three sections of 7,500-sq.ft. area arranged for two passes.

Surface Condenser—Westinghouse Electric & Manufacturing Company. One 29,500-sq.ft. condenser with welded shell construction, welded in place, active tube length 21 ft., arranged for two passes and having divided water boxes.

Condensate Pumps—Westinghouse Electric Manufacturing Company. Two 600-gal.-per-minute pumps driven by 40-hp., 440-volt motors.

Air Ejector—Westinghouse Electric & Manufacturing Company. One two-stage air ejector having surface type intermediate and after condenser.

Relief Valve—Westinghouse Electric & Manufacturing Company.

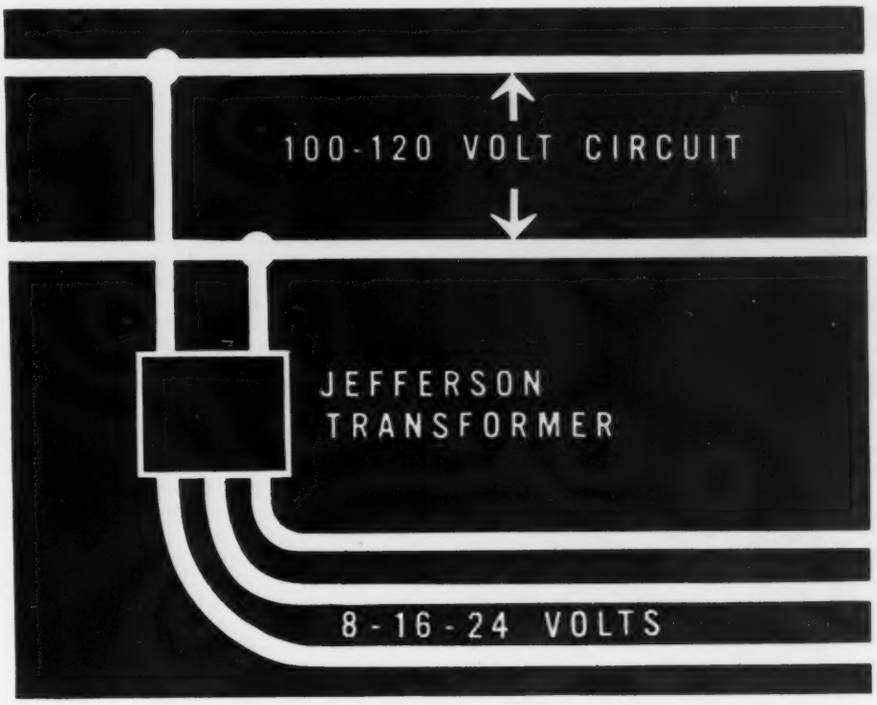
Electrical Apparatus—Circuit breaker, switchboard and regulator, General Electric Company.

Wrecking, Excavation and Building Erection—Woerman Construction Company of St. Louis.

•

Moves Plant and Offices

Slater Electric & Manufacturing Co., Inc., manufacturer of incandescent lamps, has announced the removal of its offices and factory to 728 Atlantic Avenue, Brooklyn, N. Y.



Where Do You Need Low Voltage?

Included in the wide line of Jefferson Electric Transformers are the Control Transformers needed to provide the lower voltage used in the operation of—

No. 637-361 Control Transformer with Automatic Circuit Breaker

remote control equipment
automatic stokers
oil burners
relays
valves
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fire alarms
coin-operated devices
air-conditioning systems

Standard types have 8, 16, and 24 volt secondaries while transformers with other low voltages can be furnished to meet special conditions,—both available with or without automatic circuit breakers.

The coils of Jefferson Control Transformers are layer-built, automatically wound and have triple insulation. In addition, they are vacuum treated, impregnated and baked. This represents the highest type of construction, insuring long and efficient service.

• • •

For operating 115 Volt devices from 460 or 575 Volt power circuits, a complete line of Jefferson Power Circuit Transformers is available in capacities from 50 VA to 15 KVA.

Jefferson Electric transformer engineers are ready to make recommendations and provide specific data covering your requirements. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago) Illinois. Canadian Factory: 60-64 Osler Avenue, W. Toronto, Ontario.

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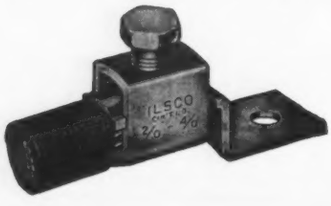

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Recent Rate Changes

West Penn Power Co. will file shortly revised rate schedules which will effect annual savings to present customers of $1,502,000, according to a recent announcement by the state Public Utility Commission. The commission also stated it had dropped its formal rate case against the company. That an agreement had been reached was announced a short time ago (Electrical World, March 22, page 134). The reduction is distributed as follows: general power, $620,000; commercial, small power, church and school, $570,000; residential and rural, $227,000; large power, $71,000; street lighting, $14,000. A total of 132 commercial customers will be increased $2,993 annually through the elimination of discriminatory schedules. Residential consumers have received most of the benefits of past reductions made by the company. Eighty-two municipal customers out of a total of 187 receive reductions.

Kentucky Utilities Co. has been ordered by the state Public Service Commission to reduce its income in the amount of $500,000 per year. The commission allowed the company credit for increased wages to its employees, effective April 1, in the amount of $107,000 per year and credit for anticipated increases in Federal and ad valorem taxes in the amount of $128,000. The commission directed the company to reduce its rates for electric service $265,000. The new rates will be put into effect as promptly as they can be equitably allocated to the various classes of consumers. It is expected that this can be done so that reductions may become effective on bills rendered on and subsequent to June 1. The commission's action was not a formal order. Hugh B. Bearden, chief consultant for the commission, said that if Kentucky Utilities objected to the request, public hearings were necessary before the company could be required to observe it. At Lexington, company officials said they would make no comment on the request "until we have received and have had an opportunity to study the order."

Tampa Electric Co. lost its case, contesting the 30 per cent reduction in electric rates. Florida Supreme Court has upheld by a 4 to 3 decision the means used by the Tampa Utility Board in ordering the Tampa Electric Co. to make the reduction which would cut consumers' bills an estimated $635,000 annually.

Wisconsin Public Service Corp. has announced a rate reduction program that may result in cuts of $400,000 to electric and gas customers in 145 communities in 20 central and northeastern Wisconsin counties. Residential, commercial, power and miscellaneous electric users will be affected.

Toledo Edison Co. and the Chamber of Commerce recently completed negotiations for a new industrial power rate in Toledo under which more than 200 firms will benefit in savings of approximately $225,000 annually. These firms were not included in the rate reductions granted by the utility a year ago. The new schedule is for one year, and if conditions permit, it will be renewed on a somewhat similar basis. The demand charge is reduced from $1.85 to $1.75, less 25 cents if the industry owns its own transformer equipment. The energy charge was reduced proportionately to give smaller manufacturers a break with larger consumers. The more power used, the greater the savings. The agreement was arrived at in a series of conferences held on the basis of the

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Makes fast-clean-easy cuts and is easy to file.

Unique design allows teeth to cut full length of blade.

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EVERSTICK ANCHORS...

Provide dependable anchoring when poles are subjected to unusual strains from storms. Made of tough, certified, rust resistant, malleable iron for extra strength and holding power. Write for new bulletin.

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BURNDY
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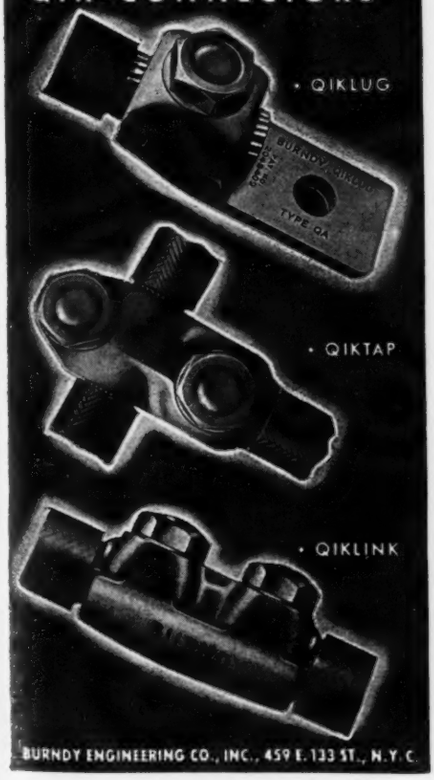


BURNDY ENGINEERING CO., INC., 459 E. 133 ST., N.Y.C.

utility's statement of its affairs and a survey made by an engineer who was retained by the Chamber of Commerce. The new rate was announced after four weeks of negotiations between a subcommittee of the manufacturers' service committee of the Chamber of Commerce, Carroll Proctor, president and general manager of the Toledo Edison Co., and three members of the Citizens' Advisory Committee.

GEORGIA POWER CO. has been ordered by the state Public Service Commission to reduce its electric wholesale rates to rural electrification associations and municipalities, bringing about total savings of approximately $175,000 a year. A 20 per cent reduction was ordered in the power purchased by the rural associations. Based on last year's consumption, this would mean a saving of approximately $55,000 a year. Approximately 40 municipalities that purchase power from the Georgia Power Co. will be affected by the other revision in rates, which was approximately a 12 per cent reduction. The saving to the municipalities affected would be approximately $120,000 a year.

ARKANSAS POWER & LIGHT CO.'s reduced electric rates for fifteen Civilian Conservation Corps camps have been approved by the state Utilities Commission. The new rate is $60 a month for up to 1,200 kw. plus two cents a kilowatt for all above that amount used. The old rate was $75 a month for up to 1,500 kilowatts plus two cents a kilowatt for all above that amount.

MOUNTAIN STATES POWER CO. has announced a general rate reduction to electric customers in northwest Montana. The state Public Service Commission has approved the reduction. Customers' savings resulting from the rate cut will total $25,000.

ARKANSAS GENERAL UTILITIES CO. has been granted authority by the state Utilities Commission to reduce rates in the towns of Warren, Wilmar, Hermitage and Ingalls, bringing about estimated savings of $6,126 annually. The new rate schedule will become effective June 1.

•

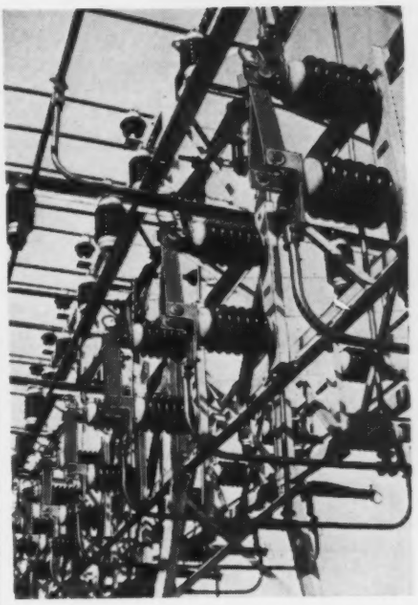
Vetoes Plant Expenditure

Branding proposed expenditure of approximately $65,000 for improvement of the Newark, Ohio, municipal power plant as a "wasteful addition to the city's indebtedness," Mayor Glen Wright has vetoed resolutions of the Council providing for a survey. Council had authorized Service Director Royal Keyes to prepare specifications and cost estimate for the improvements.

•

Builds New Plant

Seriously overcrowded facilities will be relieved by the addition of 20,000 sq. ft. of floor space in a new building just contracted for by Torrington Manufacturing Co., Torrington, Conn. The new space will be devoted to the manufacture of Airistocrat propeller fan blades and Airotor blower wheels. Occupancy of the new building is scheduled for October.



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Contacts are full-floating, self-aligning, and self-wiping. Phosphor bronze coil springs within the jaws apply firm, constant pressure to the blade. A positive latch keeps the blade closed, yet releases smoothly and easily when your operator pulls the operating ring.

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STRENGTH, ruggedness and durability are combined with definite economy in *Crapo* Galvanized Steel Strand. Low first cost, low maintenance expense are matters of record wherever this time-tested product is in use. Available in all standard grades and sizes from representative jobbers throughout the country. Or, write—

INDIANA STEEL & WIRE CO.
MUNCIE, : : INDIANA

New REA Loans Made to Power Systems

Rural Electrification Administrator Harry Slattery has agreed to lend $325,000 to a new Virginia co-operative, to take over, rehabilitate and considerably expand the system of the Bull Run Power Co. of Manassas. The new organization is known as the Prince William Electric Co-operative, and its headquarters will be those of the present company at Manassas.

The allotment of $325,000 will be used as follows:

For acquiring the electric distribution system of the Bull Run Power Co. constructed before the earlier REA loan, $59,307; $30,000 for rehabilitating these original lines; $21,000 to acquire the original 155-kw. Diesel and 50-kw. hydro generating plants of the company; $54,650 to complete the generating facilities for which REA has made earlier loans to the company; $160,042 to construct new lines and add short extensions to existing lines.

In addition, the co-operative assumes earlier obligations of the company to REA, totaling $303,000, advanced to construct rural power lines and additional generating facilities to serve them, and take over the properties which the company built with the REA funds.

Administrator Slattery also announced allotments totaling $1,956,000 for rural electrification in 16 states and Alaska. The Alaska allotment will bring power to the Matanuska Valley. About four years ago REA allotted money to the Anchorage Light & Power Co. to construct these lines, but because of difficulties in arranging proper security the loan was never consummated, REA announced. In addition, the new lines may serve three large and several small gold mines up on the hillsides.

Another allotment provides for service to the town of Fry, Ariz., a small town which is growing rapidly due to its proximity to Fort Huachuca which has tripled its personnel under the National Defense program.

Details of the recent allotments follow:

ALASKA—Matanuska Electric Assn., Inc., Palmer, Walter E. Huntley, president, $140,000 to build 75 miles of line, 354 members in the Matanuska Valley of Alaska.

ARIZONA—Sulphur Springs Valley Electric Co-operative, Inc., Willcox, Mike M. Bennett, supt., $40,000 to complete the system.

ARKANSAS—South Central Arkansas Electric Co-operative, Inc., Arkadelphia, Carroll Bell, president, $105,000 to build 99 miles of line, 357 members in Clark County.

FLORIDA—Florida Keys Electric Co-operative Assn., Inc., Key West, John A. Russell, president, $50,000 to build 89 miles of line, 525 members in Monroe County.

ILLINOIS—Tri-County Electric Co-operative, Inc., Mt. Vernon, Ill., B. H. Tuttle, supt., $15,000 to complete the system.

Engineers of many large Operating Companies now Specify

DURAPOLE
WESTERN RED CEDAR
The pole with extended service life above the ground

LESS Maintenance COSTS

DURAPOLE includes continuous slab gaining at no extra cost — this means perfect drainage and continuous flat surface any length desired; to which cross arms may be securely bolted. These two advantages alone save you much in maintenance cost; plus this you get greatly improved appearance. With these and other benefits (see below) it pays to specify DURAPOLE.

These are the benefits that make* DURAPOLE *today's cost-saving purchase

SLAB GAINED—for perfect drainage—for secure arming—for much better appearance.

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MACHINE SHAVED—for increasing life of the pole above the ground—for improved appearance.

Butt treated ½" guaranteed penetration—no reduction of sapwood in butt section.

VALENTINE CLARK CORPORATION
2516 DOSWELL AVE., ST. PAUL, MINN.
Dwight Building, Kansas City, Mo. — 84 William St., New York City

KENTUCKY—Jackson County Rural Electric Co-operative Corp., McKee, Lester Reynolds, supt., $62,000 to build 92 miles of line, 288 members in Lee, Owsley, Clay, Laurel, Jackson, Powell and Leslie counties.

LOUISIANA—Concordia Electric Co-operative, Inc., Vidalia, S. L. Winston, Jr., president, $120,000 to build 140 miles of line, 344 members in Concordia Parish.

MARYLAND—Southern Maryland Tri-County Co-operative Assn., Inc., La Plata, Forrest Coakley, supt., $50,000 to provide additional generating facilities.

MISSISSIPPI—Southwest Mississippi Electric Power Assn., Lorman, F. R. Price, supt., $121,000 to build 147 miles of line, 433 members in Claiborne, Copiah, Jefferson, Adams, Lincoln, Wilkinson, Amite and Franklin counties.

MISSOURI—Callaway County Electrical Co-operative Assn., Fulton, Raymond A. Walker, supt., $58,000 to build 67 miles of line, 157 members in Callaway, Montgomery and Boone counties.

OHIO—Paulding-Putnam Electric Co-operative, Inc., Paulding, V. E. Patterson, supt., $50,000 to build 54 miles of line, 174 members in Putnam, Van Wert and Paulding counties, Ohio, and Allen County, Ind.

OKLAHOMA—Oklahoma Electric Co-operative, Norman, Edgar W. Cralle, supt., $117,000 to build 143 miles of line, 336 members in McClain, Grady, Caddo, Oklahoma, Cleveland and Canadian counties.

SOUTH CAROLINA—Palmetto Electric Co-operative, Inc., Ridgeland. J. M. Perry, president, $50,000, partial allotment. The total mileage of the system will be 226 miles to serve 864 members in Jasper, Hampton, Beauford and Allendale counties.

TENNESSEE—Mountain Electric Co-operative, Mountain City, $100,000 to build 106 miles of line, 565 members in Johnson County.

TEXAS—Mid-South Co-operative, Inc., Navosota, John M. McCaskill, president, $100,000 to build 130 miles of line, 294 members in Walker, Madison and Grimes counties.

VIRGINIA—Craig-Botetourt Electric Co-operative, New Castle, Clay D. Huffman, supt., $32,000 to build 22 miles of line, 176 members in Botetourt, Roanoke, Craig and Alleghany counties, Va., and Monroe County, W. Va.

WISCONSIN—Bayfield Electric Co-operative, Inc., Iron River, Ed Maryland, president, $25,000 to build 20 miles of line, 56 members in Bayfield County.

Administrator Slattery also announced allotments totaling $24,500 for financing house wiring and plumbing installations in five states.

Construction contracts.

VIRGINIA—Mecklenburg Electric Co-operative, Chase City, J. E. Smith, supt., and Hammond & Long, Columbia, S. C., engineer, contract to Rockingham Construction Co., Inc., Harrisonburg, 115 miles of line, 252 members; bid, $80,250.

WASHINGTON—Public Utility District No. 1 of Cowlitz County, Longview, John B. Roche, supt., and W. S. McCrea, Jr., Tacoma, Wash., engineer, contract to Yakima Electric, Yakima, 58 miles of line, 183 members; bid, $49,258.

WISCONSIN—Clark Electric Co-operative, Greenwood, W. A. Dallman, supt., and Wisconsin Development Authority, Tenney Bldg., Madison, engineer, contract to E. W. Wylie, Inc., St. Paul, Minn., 21 miles of line, 38 members; bid, $13,697.

SEARCHLIGHT SECTION

(Classified Advertising)

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BUSINESS : : USED OR RESALE

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DISTRIBUTION ENGINEER. Southerner. Thoroughly competent in design, supervision, operation and office management. Reasonable notice due present employer. South preferred. PW-891, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

ENGINEER with wide experience in design of electrical and other equipment and ten years of marine electrical experience, interested in Supervisory, development or similar position. PW-898, Electrical World, 68 Post Street, San Francisco, Cal.

ENGINEER, Professional license, twenty years experience, mechanical and electrical design and layout, seeks better connection. Any location considered. PW-899, Electrical World, 68 Post Street, San Francisco, Cal.

CHIEF ELECTRICIAN: 25 years construction, maintenance Switchboards, Control Equipment Power Plants and Substations; Motors, Control Equipment, Testing, Trouble-shooting. Estimating and Management in Industrial Plants, 45 years old, 2 years University. Excellent references. Not interested in minor position or short term employment. PW-900, Electrical World, 520 N. Michigan Ave., Chicago, Ill.

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OFFERED—WANTED

Selling Agencies—Sales Executives
Salesmen—Additional Lines

OPPORTUNITY WANTED

MANUFACTURERS AGENT established 15 years in Southern California calling on utilities, aircraft and general industrial — can handle an additional line. RA-901, Electrical World, 68 Post Street, San Francisco, Cal.

FOR SALE

One Gould's Hydroil Centrifugal Purifier, Model 315SHVA, in use less than ten months. If interested, write for details. Box 752, Robstown, Texas.

SPECIALTIES

CABLE-SPLICERS WIPING CLOTHS. Formed-flexible finishing cloths (Patented); Flat finishing cloths; Catch cloths; Crotch cloths and Up-right joint catch cloths. Made of world-prize Herringbone Ticking or imported English Moleskin. Write us for literature and prices. Geo. E. Williams, Mfr., 3035 Aldrich Avenue, Minneapolis, Minn.

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STEEL AND BRICK BUILDING—Modern, one-story, containing approximately 28,000 sq. ft. of floor space. Building is well lighted and equipped with two 3-ton and two 5-ton floor-operated cranes. Separate service building equipped with washroom and toilet facilities, and an office building with an area of 2,400 sq. ft. Parking space nearby. Shipping facilities include spur track into main building arranged for car-floor-level loading. All contained on about 1¾ acres, approximately 75,000 square feet of land. Houston, Texas.

3-STORY BUILDING containing 42,000 sq. ft. of floor space suitable for light manufacturing, warehousing or sales purposes. Located in the center of city. Railway siding nearby. Tulsa, Okla.

6 ACRES OF LAND located at Locust Avenue and West 112th Street, with railroad siding. All cleared. Suitable for either building or storage purposes. Cleveland, Ohio.

For detailed information or an appointment to inspect these properties, write

BO 880, Electrical World
330 W. 42nd St., New York City

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Supplement to ELECTRICAL WORLD, May 3, 1941
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Table I—Data on Output and Peak Load of Largest Generating and Distr Systems in North America, 1937-1940

Public utility, lighting, power and electric railway systems in the United States, Canada and Mexico having output in excess of 100,000,000 kw.-hr. during 1940

Line No.	Company and System	1940				1939				1938				1937			
		System Peak Load (60-Minute) Incl. Purch. Energy Kw. (See Note *a*)	Peak Load on Generator Stations (60-Minute) Kw. (See Note *a*)	Generator Kw. (Nameplate Rating)	Output for Year (Incl. Purch. Energy) Thousand Kw.-Hr.	System Peak Load (60-Minute) Incl. Purch. Energy Kw. (See Note *a*)	Peak Load on Generator Stations (60-Minute) Kw. (See Note *a*)	Generator Rating, Kw.	Output for Year (Incl. Purch. Energy) Thousand Kw.-Hr.	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note *a*)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*)	Generator Rating, Kw.	Output for Year (Incl. Purch. Energy) Thousand Kw.-Hr.	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note *a*)	Peak Load on Generator Stations (30-Minute) Kw. (See Note *a*)	Generator Rating, Kw.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	
	United States																
1	Niagara Hudson System (*D*)	1,491,400	1,328,700	1,656,664	8,783,159	1,316,000	1,196,500	1,576,638	7,618,593	(*o*) 1,225,400	(*o*) 1,039,400	1,606,298	7,304,560	(*o*) 1,274,300	(*o*) 1,091,400	1,611	
2	Commonwealth Edison Co. & Subs. (*D*)	1,612,000	1,601,000	2,099,000	8,120,844	1,535,000	1,514,000	2,005,765	7,561,618	1,405,000	1,390,400	2,005,765	6,711,103	1,375,000	1,361,100	1,856	
3	Consolidated Edison Co. of New York, Inc. (*D*)	1,704,000	1,702,000	2,527,300	7,541,519	1,660,000	1,669,000	2,566,300	7,376,854	1,645,000	1,585,500	2,566,300	6,714,417	1,507,500	1,459,000	2,346	
4	Pacific Gas and Electric Co.	1,125,700	.....	1,362,066	6,058,274	(*k*) 1,059,800	.....	1,300,969	5,728,404	980,000	.....	1,250,969	5,177,338	990,200	.....	1,250	
5	American Gas and Electric Co. (Central System)	1,004,645	997,120	(*y*) 1,182,826	5,677,859	909,320	921,620	1,128,826	4,759,531	803,135	800,180	993,267	4,072,081	(*o*) 822,460	(*o*) 794,600	1,013	
6	Tennessee Valley Authority	812,400	860,900	994,105	4,746,058	674,100	674,100	838,364	2,756,966	266,000	266,000	487,338	1,288,834	(*o*) 160,400	(*o*) 160,400	413	
7	Agencies Distributing TVA Power (Consol. Rep't)	.....	.....	1,440	2,006,189	.....	.....	.....	944,123	.....	.....	.....	.....	.....	.....	.....	
8	Philadelphia Electric Co. and Subs	(*b*) 978,000	(*b*) 920,000	1,126,125	4,654,368	(*b*) 907,000	(*b*) 936,000	1,126,125	4,253,421	837,000	862,000	1,127,125	3,849,519	789,000	834,000	1,097	
9	The Detroit Edison Co.	(*k*) 866,600	(*k*) 856,700	1,095,675	3,656,860	(*k*) 769,900	(*k*) 763,400	1,020,675	3,127,969	666,900	663,900	960,825	2,689,403	660,100	653,000	930	
10	Southern California Edison Co., Ltd	(*m*) 729,200	(*m*) 727,000	975,020	3,654,396	(*m*) 684,500	.....	1,096,170	3,618,199	(*m*) 579,000	.....	931,550	3,058,175	(*m*) 580,500	.....	931	
11	Public Service Electric and Gas Co	756,800	755,500	837,700	3,317,108	700,800	644,900	737,700	2,994,947	623,400	588,000	737,700	2,678,396	575,650	519,000	684	
12	Bureau of Reclamation (Boulder Dam)	(*m*) 696,000	(*m*) 696,600	704,800	3,072,604	.....	(*b*) 589,200	704,800	2,507,932	.....	.....	539,800	1,522,627	319,200	319,200	370	
13	Duke Power Co.	626,255	.....	.....	3,054,762	(*m*) 599,275	.....	.....	2,759,247	(*m*) 530,230	.....	.....	2,307,908	(*m*) 494,745	.....	.....	
14	American Water Works and Electric Co., Inc. (*D*)	523,300	516,200	648,904	2,815,973	473,097	465,697	627,800	2,470,563	(*o*) 409,558	(*o*) 401,218	618,579	2,136,864	(*o*) 432,759	(*o*) 411,600	590	
15	Union Electric Co. of Missouri and Subs.	540,000	540,000	711,420	2,749,516	(*m*) 476,000	(*m*) 476,000	692,420	2,468,422	(*m*) 448,000	(*m*) 448,000	692,420	2,254,291	(*m*) 443,000	(*m*) 443,000	651	
16	Alabama Power Co.	614,100	.....	579,199	2,743,987	589,490	476,490	579,879	2,596,828	(*o*) 465,700	(*o*) 441,700	579,879	2,132,738	(*o*) 505,900	(*o*) 496,900	579	
17	New England Power Association (Consol.)	627,100	518,700	708,565	2,735,294	587,900	489,600	711,014	2,490,936	(*o*) 532,300	(*o*) 440,000	711,014	2,174,696	(*o*) 526,500	.....	719	
18	Duquesne Light Co.	463,400	463,000	504,000	2,412,765	422,500	424,100	504,000	2,007,780	(*o*) 349,300	(*o*) 350,100	504,000	1,654,105	(*o*) 360,100	348,300	444	
19	Georgia Power Co.	456,200	.....	381,939	2,222,839	427,300	.....	381,939	2,050,359	(*o*) 374,400	.....	382,114	1,758,406	(*o*) 361,100	(*o*) 291,100	384	
20	The Cleveland Electric Illuminating Co	453,000	453,000	523,750	2,082,867	416,900	416,900	523,750	1,820,146	(*j*) 387,214	(*j*) 387,214	527,500	1,548,630	(*j*) 360,223	(*j*) 362,223	477	
21	Consumers Power Co.	475,755	434,150	507,115	2,076,634	420,986	.....	473,715	1,733,120	(*o*) 371,070	.....	417,915	1,509,917	(*o*) 372,900	(*o*) 333,460	413	
22	Pennsylvania Power & Light Co.	396,460	312,000	391,689	1,964,168	379,956	314,400	391,689	1,874,595	(*o*) 360,300	(*o*) 302,902	391,689	1,752,164	345,000	266,800	392	
23	Con. Gas Electric Light & Power Co., Baltimore	(*e*) 351,000	233,000	273,450	1,918,655	(*e*) 307,000	215,000	250,950	(*g*) 1,646,037	(*e*) 276,000	(*o*) 142,000	230,950	(*g*) 1,430,008	(*e*) 300,000	(*o*) 144,000	230	
24	City of Los Angeles, Dept. of Water & Power	456,800	523,200	628,105	1,894,067	(*k*) 400,400	(*k*) 381,400	562,105	1,691,044	377,600	377,600	562,105	1,555,238	366,500	366,500	562	
25	Columbia Gas & Electric Corp. and Subs. (*D*)	399,840	.....	541,750	1,746,276	383,300	.....	511,750	1,572,309	345,600	.....	476,750	1,399,199	324,200	.....	406	
26	The Montana Power Co.	286,100	286,100	349,750	1,713,751	275,400	275,400	342,000	1,491,796	(*o*) 236,500	(*o*) 236,500	350,000	1,295,283	(*o*) 258,500	(*o*) 255,500	294	
27	Wisconsin Electric Power Co. and Affil. Cos. (*D*)	(*m*) 386,393	.....	538,080	1,713,364	(*m*) 356,553	.....	547,480	1,550,252	317,740	.....	530,740	1,424,858	343,061	.....	531	
28	Boston Edison Co.	399,300	326,100	389,160	1,611,442	372,590	323,265	389,160	1,453,365	(*m*) 336,995	(*m*) 293,210	359,160	1,203,804	(*m*) 305,430	(*m*) 249,040	359	
29	Northern States Power Co. (Minn.) and Subs.	(*m, s*) 351,251	(*m, s*) 346,901	492,321	1,572,011	(*m*) 329,575	(*m*) 326,575	456,661	1,461,401	(*m, s*) 299,459	(*m, s*) 294,609	460,611	1,341,865	278,374	.....	420	
30	Penn. W. & P. Co.,— Safe Harbor W. P. Corp.	367,000	367,000	341,000	1,521,131	332,000	332,000	311,000	1,319,195	(*o*) 335,000	(*o*) 335,000	311,000	1,548,165	(*o*) 335,550	(*o*) 335,500	311	
31	Puget Sound Power & Light Co.	(*m*) 269,292	(*m*) 265,090	287,690	1,245,626	(*m*) 249,310	(*m*) 228,160	315,185	1,155,039	(*m*) 233,170	(*m*) 228,170	315,245	1,047,416	(*m*) 232,410	(*m*) 230,635	319	
32	Ohio Edison Co.	285,100	281,800	368,450	1,241,717	243,400	229,100	333,450	1,189,132	(*o*) 227,300	(*o*) 224,600	333,450	1,078,285	(*o*) 243,100	(*o*) 236,000	313	
33	The Washington Water Power Co. (*v*)	225,600	209,500	203,534	1,216,271	189,600	182,400	203,534	1,033,419	(*o*) 182,100	(*o*) 182,100	203,534	980,407	(*o*) 228,200	(*o*) 193,800	203	
34	Carolina Power & Light Co.	233,906	216,800	249,050	1,186,563	255,820	196,400	249,050	923,281	(*o*) 245,540	(*o*) 194,860	249,050	890,938	(*o*) 273,280	(*o*) 198,320	249	
35	Potomac Electric Power Co.	245,000	228,000	305,000	1,090,703	218,000	201,000	255,000	993,139	(*o*) 198,000	(*o*) 178,000	255,000	910,962	(*o*) 189,000	(*o*) 154,000	220	
36	Utah Power & Light Co.	172,506	139,324	204,162	1,076,058	170,010	145,910	240,177	940,498	(*o*) 150,440	(*o*) 125,730	240,177	762,765	147,200	133,630	24	
37	New York State Electric & Gas Corp.	(*l*)	(*l*)	123,113	1,041,528	(*l*)	(*l*)	124,283	939,302	179,840	87,565	122,710	876,706	(*o*) 171,837	(*o*) 84,100	103	
38	Public Service Co. of Indiana	184,440	127,490	133,520	914,774	(*k*) 179,280	(*k*) 139,500	133,520	859,706	164,730	134,700	133,520	736,972	158,650	117,500	136	
39	Virginia Electric and Power Co.	184,300	192,000	213,635	879,046	170,500	172,400	171,535	774,282	(*o*) 142,700	(*o*) 141,800	171,535	679,448	(*o*) 133,200	(*o*) 133,900	173	
40	Northern Indiana Public Service Co.	(*k*) 162,503	82,080	115,455	874,410	(*k*) 159,196	(*k*) 82,436	115,455	799,316	141,494	82,405	111,455	707,746	137,610	82,300	91	
41	The Connecticut Light and Power Co.	189,756	158,119	194,145	869,487	174,231	147,549	194,625	780,108	(*o*) 154,070	(*o*) 127,435	194,865	670,029	154,872	129,935	190	
42	Portland General Electric Co.	184,000	139,000	183,465	842,957	171,000	144,000	183,465	744,545	(*o*) 152,000	(*o*) 140,000	183,465	676,706	(*o*) 144,000	(*o*) 140,000	183	
43	Metropolitan Edison Co.	175,500	143,600	190,928	818,719	158,700	149,800	190,928	733,497	214,300	169,000	246,198	797,956	(*o*) 186,300	(*o*) 174,400	246	
44	Kansas City Power & Light Co.	(*c, m*) 156,000	(*c, m*) 156,000	273,211	808,204	(*c, m*) 148,800	(*c, m*) 148,800	283,925	782,861	(*c, m*) 143,400	(*c, m*) 143,400	277,925	749,787	151,700	151,700	262	
45	Houston Lighting & Power Co.	157,600	154,000	206,336	785,750	147,600	146,700	206,586	740,275	(*o*) 130,400	(*o*) 129,100	181,586	684,906	(*o*) 121,200	(*o*) 117,300	181	
46	Louisiana Power & Light Co.	116,000	96,000	86,648	784,546	115,000	96,000	86,868	745,302	109,075	96,000	86,868	654,876	.....	96,000	86	
47	Gulf States Utilities Co	122,077	119,655	191,768	771,525	118,028	117,610	181,516	724,664	97,959	97,506	148,016	598,534	(*o*) 70,441	(*o*) 70,019	73	
48	Idaho Power Co.	109,600	101,000	106,222	745,391	110,225	103,110	102,410	766,549	(*o*) 106,821	(*o*) 101,935	102,135	657,375	92,302	(*o*) 86,085	100	
49	The Ohio Public Service Co.	154,700	107,400	(*y*) 104,117	743,947	143,400	106,600	129,100	655,688	116,800	90,400	129,600	530,560	129,100	97,900	123	
50	Oklahoma Gas and Electric Co.	(*b*) 130,980	(*b*) 133,232	(*y*) 167,946	693,667	(*b*) 125,276	(*b*) 121,320	(*y*) 170,176	652,459	122,336	120,452	173,476	642,904	125,096	124,104	171	
51	The California Oregon Power Co.	121,215	117,505	115,080	643,069	114,955	111,855	115,080	600,284	105,135	105,135	115,080	565,815	110,980	106,175	11	
52	The Toledo Edison Co.	137,000	144,000	180,280	642,425	147,940	140,940	180,280	553,179	130,940	113,840	180,280	474,081	116,020	106,020	17	
53	The Hartford Electric Light Co.	(*n*) 130,100	(*n*) 125,700	165,500	636,979	(*e*) 114,700	(*e*) 121,000	165,500	571,449	102,000	106,200	165,500	372,734	100,700	103,300	12	
54	Central Maine Power Co.	116,170	116,170	173,097	605,309	109,300	108,400	133,097	565,112	103,752	103,452	125,922	521,477	101,900	100,200	12	
55	Texas Power & Light Co.	128,740	101,000	96,940	603,855	133,450	107,750	96,940	638,047	(*o*) 127,400	(*o*) 104,620	98,431	604,559	(*o*) 125,610	(*o*) 104,480	9	
56	City of Seattle, Department of Lighting	120,000	148,000	249,256	592,700	(*m*) 113,000	(*m*) 136,000	239,000	469,701	(*m*) 111,000	(*m*) 111,000	239,000	439,541	(*m*) 103,000	(*m*) 103,000	23	
57	Louisville Gas and Electric Co. (Ky.) and Subs.	(*m*) 134,030	(*m*) 134,000	209,820	572,012	(*m*) 104,530	(*m*) 97,000	209,820	477,665	(*m*) 99,530	(*m*) 99,500	209,820	448,947	(*m*) 109,030	(*m*) 109,000	19	
58	Central Illinois Public Service Co.	135,600	80,800	100,000	567,147	128,200	71,700	75,000	491,175	112,800	69,900	75,000	461,301	112,400	65,400	7	
59	Public Service Co. of Colorado	114,760	112,790	157,482	545,768	108,638	107,440	157,482	499,674	(*o*) 101,480	(*o*) 99,920	155,162	481,374	(*o*) 95,310	(*o*) 94,000	12	
60	Pennsylvania Electric Co.—Subs. & Affil. (*D*)	112,740	112,740	143,961	535,586	(*k*) 107,640	(*h*) 106,440	57,100	397,671	92,200	90,200	146,675	439,914	91,150	90,070	14	
61	Hetch Hetchy Pwr. & Util. Engr. Bur.	85,800	85,800	83,000	528,727	84,700	84,700	83,000	525,993	87,800	87,800	83,000	531,402	87,700	87,700	8	
62	Arkansas Power & Light Co.	99,300	85,200	106,738	524,755	96,000	77,000	107,998	496,709	(*o*) 93,200	(*o*) 68,000	108,004	459,924	88,541	69,400	10	
63	Western Massachusetts Companies	108,600	99,400	178,975	513,659	100,400	.....	160,050	484,636	88,800	.....	160,050	472,089	(*o*) 86,000	.....	16	

Engin. Library

Supplement to ELECTRICAL WORLD, May 3, 1941
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ata on Output and Peak Load of Largest Generating and Distributing Systems in North America, 1937-1940

Public utility, lighting, power and electric railway systems in the United States, Canada and Mexico having output in excess of 100,000,000 kw.-hr. during 1940

	1940				1939				1938				1937				Line No.
	System Peak Load (60-Minute) Incl. Purch. Energy Kw. (See Note a) (3)	Peak Load on Generator Stations (60-Minute) Kw. (See Note a) (4)	Generator Kw. (Nameplate Rating) (5)	Output for Year (Incl. Purch. Energy) Thousand Kw.-Hr. (6)	System Peak Load (60-Minute) Incl. Purch. Energy Kw. (See Note a) (7)	Peak Load on Generator Stations (60-Minute) Kw. (See Note a) (8)	Generator Rating, Kw. (9)	Output for Year (Incl. Purch. Energy) Thousand Kw.-Hr. (10)	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (11)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a) (12)	Generator Rating, Kw. (13)	Output for Year (Incl. Purch. Energy) Thousand Kw.-Hr. (14)	System Peak Load (30-Minute) Incl. Purch. Energy Kw. (See Note a) (15)	Peak Load on Generator Stations (30-Minute) Kw. (See Note a) (16)	Generator Rating, Kw. (17)	Output for Year (Incl. Purch. Energy) Thousand Kw.-Hr. (18)	(19)
	1,491,400	1,328,700	1,656,664	8,783,159	1,316,000	1,196,500	1,576,638	7,618,593	(o) 1,225,400	(o) 1,039,400	1,606,298	7,304,560	(o) 1,274,300	(o) 1,091,400	1,611,342	8,056,607	1
	1,612,000	1,601,000	2,099,000	8,120,844	1,535,000	1,514,000	2,005,765	7,561,618	1,405,000	1,390,400	2,005,765	6,711,103	1,375,000	1,361,100	1,856,200	7,124,493	2
nc. (D)	1,704,000	1,702,000	2,527,300	7,541,519	1,660,000	1,669,000	2,566,300	7,376,854	1,645,000	1,585,500	2,566,300	6,714,417	1,507,500	1,459,000	2,346,200	6,538,147	3
	1,125,700		1,362,066	6,058,274	(k) 1,059,800		1,300,969	5,728,404	980,000		1,250,969	5,177,338	990,200		1,250,969	5,182,043	4
System)	1,004,645	997,120	(y) 1,182,826	5,677,859	909,320	921,620	1,128,826	4,759,531	803,135	800,180	993,267	4,072,081	(o) 822,460	(o) 794,600	1,013,257	4,780,963	5
	812,400	860,900	994,105	4,746,058	674,100	674,100	838,364	2,756,966	266,000	266,000	487,338	1,288,834	(o) 160,400	(o) 160,400	413,300	494,799	6
Consol. Rep't)			1,440	2,006,189				944,123									7
	(b) 978,000	(b) 920,000	1,126,125	4,654,368	(b) 907,000	(b) 936,000	1,126,125	4,253,421	837,000	862,000	1,127,125	3,849,519	789,000	834,000	1,097,375	3,833,949	8
	(k) 866,600	(k) 856,700	1,095,675	3,656,860	(k) 769,900	(k) 763,400	1,020,675	3,127,969	666,900	663,900	960,825	2,689,403	660,100	653,000	930,825	3,217,075	9
	(m) 729,200	(m) 727,000	975,020	3,654,396	(m) 684,500		1,096,170	3,618,199	(m) 579,000		931,550	3,058,175	(m) 580,500		931,550	3,138,654	10
	756,800	755,500	837,700	3,317,108	700,800	644,900	737,700	2,994,947	623,400	588,000	737,700	2,678,396	575,650	519,000	684,450	2,747,123	11
	(m) 696,000	(m) 696,600	704,800	3,072,604		(b) 589,200	704,800	2,507,932			539,800	1,522,627	319,200	319,200	370,000	1,166,681	12
	626,255			3,054,762	(m) 599,275			2,759,247	(m) 530,230			2,307,908	(m) 494,745			2,385,189	13
Inc. (D)	523,300	516,200	648,904	2,815,973	473,097	465,697	627,800	2,470,563	(o) 409,558	(o) 401,218	618,579	2,136,864	(o) 432,759	(o) 411,600	590,679	2,543,471	14
	540,000	540,000	711,420	2,749,516	(m) 476,000	(m) 476,000	692,420	2,468,422	(m) 448,000	(m) 448,000	692,420	2,254,291	(m) 443,000	(m) 443,000	651,670	2,399,584	15
	614,100		579,199	2,743,987	589,490	476,490	579,879	2,596,828	(o) 465,700	(o) 441,700	579,879	2,132,738	(o) 505,900	(o) 496,900	579,744	2,347,861	16
	627,100	518,700	708,565	2,735,294	587,900	489,600	711,014	2,490,936	(o) 532,300	(o) 440,000	711,014	2,174,696	(o) 526,500		719,310	2,373,707	17
	463,400	463,000	504,000	2,412,765	422,500	424,100	504,000	2,007,780	(o) 349,300	(o) 350,100	504,000	1,654,105	(o) 360,100	348,300	444,000	1,836,112	18
	456,200		381,939	2,222,839	427,300		381,939	2,050,359	(o) 374,400		382,114	1,758,406	(o) 361,100	(o) 291,100	384,624	1,870,625	19
	453,000	453,000	523,750	2,082,867	416,900	416,900	523,750	1,820,146	(j) 387,214	(j) 387,214	527,500	1,548,630	(j) 360,223	(j) 362,223	477,500	1,707,031	20
	475,755	434,150	507,115	2,076,634	420,986		473,715	1,733,120	(o) 371,070		417,915	1,509,917	(o) 372,900	(o) 333,460	413,215	1,691,884	21
	396,460	312,000	391,689	1,964,168	379,956	314,400	391,689	1,874,595	(o) 360,300	(o) 302,902	391,689	1,752,164	345,000	266,800	392,189	1,778,250	22
ltimore	(e) 351,000	233,000	273,450	1,918,655	(e) 307,000	215,000	250,950	(g) 1,646,037	(e) 276,000	(o) 142,000	230,950	(g) 1,430,008	(e) 300,000	(o) 144,000	230,950	(g) 1,508,886	23
ower	456,800	523,200	628,105	1,894,067	(k) 400,400	(k) 381,400	562,105	1,691,044	377,600	377,600	562,105	1,555,238	366,500	366,500	562,105	1,506,171	24
(D)	399,840		541,750	1,746,276	383,300		511,750	1,572,309	345,600		476,750	1,399,199	324,200		406,750	1,510,463	25
	286,100	286,100	349,750	1,713,751	275,400	275,400	342,000	1,491,796	(o) 236,500	(o) 236,500	350,000	1,295,283	(o) 258,500	(o) 255,500	294,000	1,559,436	26
os. (D)	(m) 386,393		538,080	1,713,364	(m) 356,553		547,480	1,550,252	317,740		530,740	1,424,858	343,061		531,714	1,506,345	27
	399,300	326,100	389,160	1,611,442	372,590	323,265	389,160	1,453,365	(m) 336,995	(m) 293,210	359,160	1,203,804	(m) 305,430	(m) 249,040	359,160	1,274,633	28
Subs.	(m, s) 351,251	(m, s) 346,901	492,321	1,572,011	(m) 329,575	(m) 326,575	456,661	1,461,401	(m, s) 299,459	(m, s) 294,609	460,611	1,341,865	278,374		420,151	1,319,245	29
Corp.	367,000	367,000	341,000	1,521,131	332,000	332,000	311,000	1,319,195	(o) 335,000	(o) 335,000	311,000	1,548,165	(o) 335,550	(o) 335,500	311,000	1,848,643	30
	(m) 269,292	(m) 265,090	287,690	1,245,626	(m) 249,310	(m) 228,160	315,185	1,155,039	(m) 233,170	(m) 228,170	315,245	1,047,416	(m) 232,410	(m) 230,635	319,745	1,233,901	31
	285,100	281,800	368,450	1,241,717	243,400	229,100	333,450	1,189,132	(o) 227,300	(o) 224,600	333,450	1,078,285	(o) 243,100	(o) 236,000	313,450	1,280,943	32
	225,600	209,500	203,534	1,216,271	189,600	182,400	203,534	1,033,419	(o) 182,100	(o) 182,100	203,534	980,407	(o) 228,200	(o) 193,800	203,534	(v) 1,278,809	33
	233,906	216,800	249,050	1,186,563	255,820	196,400	249,050	923,281	(o) 245,540	(o) 194,860	249,050	890,938	(o) 273,280	(o) 198,320	249,050	1,035,987	34
	245,000	228,000	305,000	1,090,703	218,000	201,000	255,000	993,139	(o) 198,000	(o) 178,000	255,000	910,962	(o) 189,000	(o) 154,000	220,000	835,168	35
	172,506	139,324	204,162	1,076,058	170,010	145,910	240,177	940,498	(o) 150,440	(o) 125,730	240,177	762,765	147,200	133,630	241,142	919,184	36
	(l)	(l)	123,113	1,041,528	(l)	(l)	124,283	939,302	179,840	87,565	122,710	876,706	(o) 171,837	(o) 84,100	103,445	819,824	37
	184,440	127,490	133,520	914,774	(k) 179,280	(k) 139,500	133,520	859,706	164,730	134,700	133,520	736,972	158,650	117,500	136,520	774,931	38
	184,300	192,000	213,635	879,046	170,500	172,400	171,535	774,282	(o) 142,700	(o) 141,800	171,535	679,448	(o) 133,200	(o) 133,900	173,035	664,860	39
	(k) 162,503	82,080	115,455	874,410	(k) 159,196	(k) 82,436	115,455	799,316	141,494	82,405	111,455	707,746	137,610	82,300	91,455	811,820	40
	189,756	158,119	194,145	869,487	174,231	147,549	194,625	780,108	(o) 154,070	(o) 127,435	194,865	670,029	154,872	129,935	196,815	748,186	41
	184,000	139,000	183,465	842,957	171,000	144,000	183,465	744,545	(o) 152,000	(o) 140,000	183,465	676,706	(o) 144,000	(o) 140,000	183,000	704,759	42
	175,500	143,600	190,928	818,719	158,700	149,800	190,928	733,497	214,300	169,000	246,198	797,956	(o) 186,300	(o) 174,400	246,198	952,593	43
	(c, m) 156,000	(c, m) 156,000	273,211	808,204	(c, m) 148,800	(c, m) 148,800	283,925	782,861	(c, m) 143,400	(c, m) 143,400	277,925	749,787	151,700	151,700	263,211	757,407	44
	157,600	154,000	206,336	785,750	147,600	146,700	206,586	740,275	(o) 130,400	(o) 129,100	181,586	684,906	(o) 121,200	(o) 117,300	181,586	659,912	45
	116,000	96,000	86,648	784,546	115,000	96,000	86,868	745,302	109,075	96,000	86,868	654,876		96,000	86,874	760,703	46
	122,077	119,655	191,768	771,525	118,028	117,610	181,516	724,664	97,959	97,506	148,016	598,534	(o) 70,441	(o) 70,019	75,596	367,401	47
	109,600	101,000	106,222	745,391	110,225	103,110	102,410	766,549	(o) 106,821	(o) 101,935	102,135	657,375	92,302	(o) 86,085	100,985	609,466	48
	154,700	107,400 (y)	104,117	743,947	143,400	106,600	129,100	655,688	116,800	90,400	129,600	530,560	129,100	97,900	125,100	624,774	49
	(b) 130,980	(b) 133,232 (y)	167,946	693,667	(b) 125,276	(b) 121,320	(y) 170,176	652,459	122,336	120,452	173,476	642,904	125,096	124,104	173,676	691,821	50
	121,215	117,505	115,080	643,069	114,955	111,855	115,080	600,284	105,135	105,135	115,080	565,815	110,980	106,175	115,430	575,585	51
	137,000	144,000	180,280	642,425	147,940	140,940	180,280	553,179	130,940	113,840	180,280	474,081	116,020	100,020	127,300	551,993	52
	(n) 130,100	(n) 125,700	165,500	636,979	(e) 114,700	(e) 121,000	165,500	571,449	102,000	106,200	165,500	372,734	100,700	103,300	125,500	242,016	53
	116,170	116,170	173,097	605,309	109,300	108,400	133,097	565,112	103,752	103,452	125,922	521,477	101,900	100,200	125,922	536,254	54
	128,740	101,000	96,940	603,855	133,450	107,750	96,940	638,047	(o) 127,400	(o) 104,620	98,431	604,559	(o) 125,610	(o) 104,480	98,616	588,397	55
	120,000	148,000	249,256	592,700	(m) 113,000	(m) 136,000	239,000	469,701	(m) 111,000	(m) 111,000	239,000	439,541	(m) 103,000	(m) 103,000	239,000	419,977	56
Subs.	(m) 134,030	(m) 134,000	209,820	572,012	(m) 104,530	(m) 97,000	209,820	477,665	(m) 99,530	(m) 99,500	209,820	448,947	(m) 109,030	(m) 109,000	191,320	434,964	57
	135,600	80,800	100,000	567,147	128,200	71,700	75,000	491,175	112,800	69,900	75,000	461,301	112,400	65,400	75,000	459,167	58
	114,760	112,790	157,482	545,768	108,638	107,440	157,482	499,674	(o) 101,480	(o) 99,920	155,162	481,374	(o) 95,310	(o) 94,000	126,562	472,369	59
(D)	112,740	112,740	143,961	535,586	(h) 107,640	(h) 106,440	57,100	397,671	92,200	90,200	146,675	439,914	91,150	90,070	146,675	475,274	60
	85,800	85,800	83,000	528,727	84,700	84,700	83,000	525,993	87,800	87,800	83,000	531,402	87,700	87,700	83,300	506,712	61
	99,300	85,200	106,738	524,755	96,000	77,000	107,998	496,709	(o) 93,200	(o) 68,000	108,004	459,924	88,541	69,400	108,514	452,466	62
	108,600	99,400	178,975	513,659	100,400		160,050	484,636	88,800		160,050	472,089	(o) 86,000		160,750	494,773	63
53	The Hartford Electric Light Co		(n) 130,100	(n) 125,700	165,500	636,979	(e) 114,700	(e) 121,000	165,500	571,449	102,000	106,200	165,500	372,734	101,900	103,300	

	108,600		99,400		178,975		513,659		100,400			160,050		484,636		88,800		160,050		472,089	(o)	86,000				160,750		494,773	63			
53	The Hartford Electric Light Co.		130,100	(n)	125,700		165,500		636,979	(e)	114,700	(e)	121,000		165,500		571,449		102,000		106,200		165,500		572,754		100,700		165,500		125
54	Central Maine Power Co.		116,170		116,170		173,097		605,309		109,300		108,400		133,097		565,112		103,752		103,452		125,922		521,477		101,900		100,200		125
55	Texas Power & Light Co.		128,740		101,000		96,940		603,855		133,450		107,750		96,940		638,047	(o)	127,400	(o)	104,620		98,431		604,559	(o)	125,610	(o)	104,480		98
56	City of Seattle, Department of Lighting		120,000		148,000		249,256		592,700	(m)	113,000	(m)	136,000		239,000		469,701	(m)	111,000	(m)	111,000		239,000		439,541	(m)	103,000	(m)	103,000		239
57	Louisville Gas and Electric Co. (Ky.) and Subs.	(m)	134,030	(m)	134,000		209,820		572,012	(m)	104,530	(m)	97,000		209,820		477,665	(m)	99,530	(m)	99,500		209,820		448,947	(m)	109,030	(m)	109,000		191
58	Central Illinois Public Service Co.		135,600		80,800		100,000		567,147		128,200		71,700		75,000		491,175		112,800		69,900		75,000		461,301		112,400		65,400		75
59	Public Service Co. of Colorado		114,760		112,790		157,482		545,768		108,638		107,440		157,482		499,674	(o)	101,480	(o)	99,920		155,162		481,374	(o)	95,310	(o)	94,000		126
60	Pennsylvania Electric Co.—Subs. & Affil. (*D*)		112,740		112,740		143,961		535,586	(h)	107,640	(h)	106,440		57,100		397,671		92,200		90,200		146,675		439,914		91,150		90,070		146
61	Hetch Hetchy Pwr. & Util. Engr. Bur.		85,800		85,800		83,000		528,727		84,700		84,700		83,000		525,993		87,800		87,800		83,000		531,402		87,700		87,700		83
62	Arkansas Power & Light Co.		99,300		85,200		106,738		524,755		96,000		77,000		107,998		496,709	(o)	93,200	(o)	68,000		108,004		459,924		88,541		69,400		108
63	Western Massachusetts Companies		108,600		99,400		178,975		513,659		100,400				160,050		484,636		88,800				160,050		472,089	(o)	86,000				160
64	New Orleans Public Service, Inc.		101,000		101,000		138,000		508,685		96,000		107,000		138,000		470,042		84,000		96,000		138,000		421,447	(r)	85,000	(r)	105,000		108
65	Rochester Gas and Electric Corp.		114,358		111,185		162,250		504,238		108,174		103,050		163,350		472,093	(o)	93,109	(o)	85,760		163,350		444,889	(o)	95,803	(o)	86,560		138
66	Northwestern Electric Co.		103,599		56,099		52,100		502,131		109,200		50,000		52,100		548,761	(o)	105,400	(o)	56,700		52,100		421,490	(o)	82,600	(o)	51,200		52
67	City of Tacoma, Dept. of Public Utilities		92,000		92,000		148,000		501,408		84,000		84,000		148,000		417,408		73,000		73,000		148,000		344,818	(o)	69,000	(o)	78,000		158
68	Texas Electric Service		105,760		91,960		96,876		497,853		109,962		98,321		98,126		479,421	(o)	102,224	(o)	93,102		98,126		470,263	(o)	83,988	(o)	83,369		98
69	Columbus and Southern Ohio Electric Co.		112,925		111,725		181,350		496,847		97,600		97,600		183,350		456,361	(f)	84,900	(f)	84,900		153,475		413,516	(o)	81,000	(o)	81,000		153
70	Minnesota Power & Light Co.		92,617		92,617		125,181		493,692		91,758		91,758		125,331		436,353	(o)	87,341	(o)	87,341		125,331		402,417	(o)	93,208	(o)	93,208		125
71	Florida Power & Light Co.		150,127		149,567		163,593		483,667		120,198		119,628		139,028		418,945	(o)	107,984	(o)	107,604		139,068		369,724	(o)	93,800	(o)	93,470		139
72	Montaup Electric Co.		120,400		74,850		75,000		482,707		107,600		76,500		75,000		466,829		103,500		76,800		75,000		407,600		101,900		74,650		75
73	The United Illuminating Co.		110,100		110,100		160,000		475,864			(h)	101,100		160,000		409,369	(m, h)	94,900	(m, h)	94,900		160,000		347,708			(h)	86,900		160
74	Nebraska Power Co.		93,700		92,800		111,750		454,863		84,200		83,300		111,750		413,803	(o)	78,600	(o)	78,600		111,500		389,728	(o)	81,600	(o)	81,600		106
75	Salt River Valley Water Users' Asso.	(m)	72,725	(m)	45,900		80,950		449,051						80,950		362,509	(m)	76,800	(m)	76,800		80,050		419,781	(o)	110,475	(o)	68,975		70
76	Jersey Central Power & Light Co.		87,600		91,100		137,650		447,964		82,300		87,100		137,650		350,150		74,300		74,900		137,650		314,262		69,200		74,500		137
77	Wisconsin Public Service Corp. and Sub. (*D*)		79,200		79,200		106,686		419,768		73,440		73,440		106,686		389,668		66,500		66,500		109,061		339,648	(o)	64,888	(o)	64,888		89
78	The Nevada-California Electric Corp.		78,100		44,400		57,010		419,404		74,400		43,700		59,010		416,921		79,400		72,000		101,260		458,286		77,800		74,200		101
79	Long Island Lighting System		118,020		118,020		238,300		416,724	(b)	113,000	(b)	113,000		239,100		389,103		104,000		104,000		238,100		365,929		97,200		97,200		166
80	Virginia Public Service Co.		91,100		90,700		97,468		415,944		84,100		83,800		98,508		356,725		68,800		66,900		97,668		311,106	(o)	61,200	(o)	58,600		98
81	South Carolina Electric & Gas Co.		99,900		99,900		97,130		415,862		97,500		90,400	(y)	90,630		333,564		205,000		197,000		227,130		439,485	(o)	139,700	(o)	139,700		227
82	Central Illinois Light Co.	(h)					113,500		414,328	(m)	84,445	(m)	83,295		113,500		388,871	(o)	75,346	(m)	74,570		88,500		343,762	(o)	77,716	(m)	76,300		88
83	Atlantic City Electric Co.		80,100		80,100	(y)	120,000		384,392		74,900		74,900		120,000		347,127	(o)	71,600	(o)	71,600		120,000		304,348	(o)	68,500	(o)	68,500		120
84	Wisconsin P. & L. Co.—South Beloit W. G. & E. Co.		78,105		75,485		94,266		376,385		76,300		73,430		90,195		347,846		72,510		69,365		88,265		329,252		70,100		68,750		86
85	Bonneville Power Administration		115,000		117,000		140,400		374,616		90,000		90,000		86,400		151,770														
86	Birmingham Electric Co.		71,229				11,300		370,769		66,241				11,300		332,958	(o)	59,401				11,300		302,477	(o)	56,198				11
87	Dallas Power & Light Co.		81,000		81,000		113,750		355,866		78,000		78,000		113,750		344,227	(o)	72,000	(o)	72,000		113,750		319,772	(o)	68,000	(o)	68,000		82
88	Central Hudson Gas & Electric Corp.		71,500		27,000		35,480		350,866		71,700	(d)	66,000		35,480		306,432	(o)	52,800	(d, o)	49,800		35,480		253,631	(o)	48,600	(d, o)	46,500		55
89	Pennsylvania Edison Co.		70,590		69,390		79,600		348,568		70,800		66,760		80,200		311,603		58,505		57,405		80,200		277,041	(o)	66,700	(o)	66,600		80
90	The Connecticut Power Co.		77,500	(h)			49,340		336,591	(s)	42,500				49,340		312,764						49,560		283,829						49
91	Central Power and Light Co.		69,195		60,195		84,003		336,540		65,960		53,660		76,503		320,905		60,600				75,943		297,919		60,820		50,255		76
92	Kansas Gas and Electric Co.		66,100		65,300		89,000		335,809		63,500		63,400		89,000		305,033	(o)	59,200	(o)	59,200		89,000		305,724	(o)	57,500	(o)	57,300		66
93	Public Service Co. of New Hampshire		78,330		73,330		124,944		333,705		73,250		70,100		126,444		313,592	(o)	68,250	(o)	66,400		127,369		268,618	(o)	62,905	(o)	60,805		107
94	The Scranton Electric Co.		79,200		79,200	(y)	117,700		326,779		85,100		85,100		117,700		305,819	(o)	69,000	(o)	69,000		117,700		284,482	(o)	59,700	(o)	59,700		117
95	San Diego Gas & Electric Co.		87,800		80,600		99,000		325,960	(b)	72,600	(b)	72,500		99,000		264,027		64,550		62,500		99,000		248,639		59,800		56,800		74
96	Pacific Power & Light Co.		62,595		23,960		31,967		321,883		59,490				31,817		283,301	(o)	56,880				31,817		279,592	(m)	54,550				30
97	Southwestern Gas and Electric Co.		54,557		50,000		54,515		320,878		53,358		47,700		55,515		311,909	(o)	49,725				59,265		305,528		49,762		34,100		44
98	Public Service Co. of Oklahoma		64,430		57,100		99,241		312,567		63,700		57,000		99,241		291,687		59,600		52,000		99,436		265,968		55,000		48,500		76
99	Pennsylvania Power Co.		63,800		43,600		37,500		304,848		53,400		39,200		37,500		255,017	(o)	45,000				2,500		207,993	(o)	51,870				2
100	Northern Indiana Power Co.		60,100		7,750		16,384		293,135	(k)	57,860	(k)	10,720		17,384		272,027		51,840		400		22,384		224,805		47,390		7,500		23
101	The Empire District Electric Co.		55,700		55,700		98,820		288,943	(m)	54,300	(m)	54,300		93,220		268,237	(m)	51,800	(m)	51,800		93,220		262,896	(m)	57,400	(m)	57,400		143
102	West Texas Utilities Co.		55,933		53,840	(y)	52,082		286,415		54,750		49,650		52,442		274,473	(o)	51,650				52,942		272,091		54,900				53
103	San Antonio Public Service Co.		57,971		54,100		98,500		282,916		57,673		57,600		99,400		260,411	(o)	56,372	(o)	56,300		99,400		244,164		59,629		53,729		99
104	Florida Power Corp.		58,900		53,000		58,824		264,860		60,900		54,300		58,824		226,405		52,100		41,000		58,754		181,886	(o)	43,100	(o)	42,100		58
105	Sioux City G. & E. Co.—Iowa P. S. Co. System		59,010		57,880		90,568		263,240		54,513		47,547		89,997		244,027	(o)	55,828	(o)	47,745		88,497		250,983		51,010		48,735		78
106	New Bedford Gas & Edison Light Co.		61,900		61,900		88,000		261,417		57,900		57,900		92,000		237,308		48,600		48,600		92,000		186,313	(o)	56,800	(o)	56,800		92
107	Lexington Water Power Co.		118,000		118,000		130,000		259,668		116,000		116,000		130,000		289,792														
108	Des Moines Electric Light Co. (*D*)				57,325		107,400		259,617				55,000		107,400		244,459		61,900		61,900		72,500		246,121		54,000		54,000		74
109	Memphis Generating Co.				54,500		54,000		253,559																						
110	Delaware Power & Light Co.		50,388		(h)	(y)	22,500		252,014		45,288		5,000		22,500		220,707	(o)	38,928	(o)	4,000		22,500		195,301	(o)	37,810	(o)	11,500		22
111	Mississippi Power & Light Co.		56,539				14,608		250,892		51,600		4,700		15,170		239,128	(o)	59,755	(o)	7,268		15,170		240,306	(o)	49,459	(o)	5,560		15
112	Blackstone Valley Gas & Electric Co.		58,706				35,350		242,515		52,885				35,350		232,342	(o)	52,759	(o)	21,230		35,350		196,378	(o)	54,488	(o)	33,560		35
113	Indiana Service Corp.		48,000		30,900		31,000		236,077		47,200		28,100		31,000		198,243	(m)	42,600	(m)	22,600		31,000		165,343		46,100		24,000		31
114	Inland Power & Light Co.		54,200		51,485		45,800		235,105		51,575		51,575		45,800		240,854	(o)	51,200	(o)	51,200		45,800		237,574	(o)	51,560	(o)	51,560		45
115	City of Detroit Public Lighting Commission		42,250		40,000		80,000		233,224		53,000		50,250		80,000		212,642		68,000		63,000		80,000		214,375	(x)	53,000	(x)	48,000		80
116	The Sanitary District of Chicago		42,618		27,550	(X)	35,000		228,675		42,060		24,325		35,000		211,366		41,341		23,200		35,000		216,396	(o)	40,130	(o)	22,967		35
117	Interstate Power Co., (Del.) and Subs.*		12,317		49,322		76,594		225,126		56,492		46,033		73,919		203,360		49,959		41,773		73,699		182,594		46,707		38,052		71
118	New Jersey Power & Light Co.		79,100		60,100		55,270		221,350		85,000		53,000		55,270		204,602														
119	Iowa Electric Light and Power Co.	(k)	52,515	(k)	52,515		58,903		220,887		50,000		50,000		60,263		204,019		43,191		43,191		56,963		189,270		40,922		40,922		63
120	Cumberland County Power and Light Co.		47,200		28,200		66,075		215,413		47,140		26,140		66,075		210,056		43,940		29,240		68,662		190,467	(o)	42,280	(o)	26,280		61
121	Mountain States Power Co.		30,500				21,797		214,186						22,541		185,843														
122	South Carolina Power Co.	(h)	40,600				43,170		200,398		35,100				42,170		181,780	(o)	31,600	(o)	26,700		41,370		160,707	(o)	29,000	(o)	29,000		41
123	Mississippi Power Co.		40,666				17,386		198,814		40,939		6,900		17,490		196,509	(o)	33,772	(o)	5,700		18,702		174,259	(o)	33,397	(o)	5,900		18
124	City of Cleveland Dept. of Public Utilities		44,000		42,000		50,000		197,291		42,150		42,150		50,000		183,260		40,800		40,800		50,000		170,232		41,000		41,000		50
125	Tampa Electric Co.		50,200		42,000		42,500		196,115		48,800		41,400		42,500		187,584		43,800		42,500		42,500		171,654		39,400		38,400		42
126	Central Arizona Light and Power Co.		44,300		40,000		43,000		180,247		34,400		34,500		28,000		135,858	(o)	33,100	(o)	32,100		28,000		133,631		31,300		19,400		15
127	Turlock-Modesto Irrigation Districts		22,900		40,800		32,000		178,963		38,500		38,500		35,000		180,077		40,700		40,700		35,000		193,628	(o)	40,560	(o)	40,560		35
128	Jacksonville Municipal Light Plant		42,400		42,400		81,500		176,531	(m)	38,000		38,000		81,500		159,286		34,100		34,100		54,500		138,415		31,800		31,800		54
129	Rumford Falls Power Co.	(m)	31,010	(m)	31,010		29,640		171,608	(m)	29,600	(m)	29,600		28,400		172,836	(m)	30,000	(m)	30,000		28,350		182,500						
130	Kansas City, Kan. Board of Public Utilities		33,800		33,800		69,000		169,913		32,600		32,600		69,000		155,988	(o)	30,500	(o)	30,500		69,000		147,814	(o)	29,400	(o)	29,400		39
131	Southern Indiana Gas and Electric Co.		39,100		39,100		62,800		168,752		34,000		34,000		62,800		149,787	(o)	33,500	(o)	33,500		67,800		130,435	(o)	35,500	(o)	35,500		50
132	City of Lansing Bd. of Wtr. & Elec. Lt. Comm'rs.		45,162		45,162		87,700		167,105		38,952		38,952		59,950		140,099		36,970		36,970		56,200		115,392		37,271		37,271		56
133	PUD No. 1, Cowlitz County, Wash.*		33,400		31,000		27,000		165,357																						
134	Iowa-Nebraska Light and Power Co.		39,500		34,080		47,500		164,916		37,105		31,640		47,335		155,764	(o)	35,990	(o)	31,280		47,335		146,723	(o)	34,200	(o)	28,180		45
135	Lower Colorado River Authority		51,300		49,900		49,991		164,351																						
136	Laclede Power & Light Co.				37,000		68,500		162,964				36,400		46,500		155,085		33,400		33,400		48,500		146,657	(m)	32,200	(m)	26,000		33
137	Bangor Hydro-Electric Co.		33,160		33,160		36,115		160,184		32,030		32,030		35,960		130,912				26,660		33,460		125,652	(o)	24,460	(o)	24,460		31
138	El Paso Electric Co.		33,100		33,100		56,649		157,325		32,000		32,000		56,529		143,289		28,900		28,900		56,529		135,757		26,600		26,600		56
139	Central Illinois Electric and Gas Co.	(k)	35,687				47,438		155,492	(k)	30,120				47,438		133,080		25,950				47,438		116,378		27,700				47
140	Nebraska Public Power System		61,800		61,800		131,838		153,372																						
141	Panhandle Power & Light Co.		24,000		24,000		53,096		148,581		18,200		18,200		30,000		107,610														
142	Staten Island Edison Corp.		38,600		38,600		46,000		148,546		36,731		37,300		46,000		140,801		33,700		33,400		47,500		127,392	(o)	31,700	(o)	31,700		42
143	The Marion-Reserve Power Co.				19,200		27,000		146,631				16,200		27,000		129,324														
144	Lassen County Gas & Electric Corp.		27,320				42,000	(o)	55,000		26,140		44,200		55,000		133,862	(o)	25,180	(o)	41,400		55,000		130,017	(o)	26,470	(o)	44,670		55

		128,740		101,000		96,940		603,855		133,450		107,750		96,940		638,047	(o)	127,400	(o)	104,620		98,431		604,559	(o)	125,610	(o)	104,480		98,616		588,397	
		120,000		148,000		249,256		592,700	(m)	113,000	(m)	136,000		239,000		469,701	(m)	111,000	(m)	111,000		239,000		439,541	(m)	103,000	(m)	103,000		239,000		419,977	
Subs.	(m)	134,030	(m)	134,000		209,820		572,012	(m)	104,530	(m)	97,000		209,820		477,665	(m)	99,530	(m)	99,500		209,820		448,947	(m)	109,030	(m)	109,000		191,320		434,964	
		135,600		80,800		100,000		567,147		128,200		71,700		75,000		491,175		112,800		69,900		75,000		461,301		112,400		65,400		75,000		459,167	
		114,760		112,790		157,482		545,768		108,638		107,440		157,482		499,674	(o)	101,480	(o)	99,920		155,162		481,374	(o)	95,310	(o)	94,000		126,562		472,369	
(D)		112,740		112,740		143,961		535,586	(h)	107,640	(h)	106,440		57,100		397,671		92,200		90,200		146,675		439,914		91,150		90,070		146,675		475,274	
		85,800		85,800		83,000		528,727		84,700		84,700		83,000		525,993		87,800		87,800		83,000		531,402		87,700		87,700		83,300		506,712	
		99,300		85,200		106,738		524,755		96,000		77,000		107,998		496,709	(o)	93,200	(o)	68,000		108,004		459,924		88,541		69,400		108,514		452,466	
		108,600		99,400		178,975		513,659		100,400		.....		160,050		484,636		88,800		.....		160,050		472,089	(o)	86,000		.....		160,750		494,773	
		101,000		101,000		138,000		508,685		96,000		107,000		138,000		470,042		84,000		96,000		138,000		421,447	(r)	85,000	(r)	105,000		108,000		444,434	
		114,358		111,185		162,250		504,238		108,174		103,050		163,350		472,093	(o)	93,109	(o)	85,760		163,350		444,889	(o)	95,803	(o)	86,560		138,435		461,273	
		103,599		56,099		52,100		502,131		109,200		50,000		52,100		548,761	(o)	105,400	(o)	56,700		52,100		421,490	(o)	82,600	(o)	51,200		52,100		439,684	
		92,000		92,000		148,000		501,408		84,000		84,000		148,000		417,408		73,000		73,000		148,000		344,818	(o)	69,000	(o)	78,000		158,000		374,838	
		105,760		91,960		96,876		497,853		109,962		98,321		98,126		479,421	(o)	102,224	(o)	93,102		98,126		470,263	(o)	83,988	(o)	83,369		98,078		477,809	
		112,925		111,725		181,350		496,847		97,600		97,600		183,350		456,361	(f)	84,900	(f)	84,900		153,475		413,516	(o)	81,000	(o)	81,000		153,475		419,604	
		92,617		92,617		125,181		493,692		91,758		91,758		125,331		436,353	(o)	87,341	(o)	87,341		125,331		402,417	(o)	93,208	(o)	93,208		125,331		460,171	
		150,127		149,567		163,593		483,667		120,198		119,628		139,028		418,945	(o)	107,984	(o)	107,604		139,068		369,724	(o)	93,800	(o)	93,470		139,033		341,281	
		120,400		74,850		75,000		482,707		107,600		76,500		75,000		466,829		103,500		76,800		75,000		407,600		101,900		74,650		75,000		368,319	
		110,100		110,100		160,000		475,864		.....	(h)	101,100		160,000		409,369	(m, h)	94,900	(m, h)	94,900		160,000		347,708		.....	(h)	86,900		160,000		372,354	
		93,700		92,800		111,750		454,863		84,200		83,300		111,750		413,803	(o)	78,600	(o)	78,600		111,500		389,728	(o)	81,600	(o)	81,600		106,500		397,621	
	(m)	72,725	(m)	45,900		80,950		449,051		.....		.....		80,950		362,509	(m)	76,800	(m)	76,800		80,050		419,781	(o)	110,475	(o)	68,975		70,050		496,414	
		87,600		91,100		137,650		447,964		82,300		87,100		137,650		350,150		74,300		74,900		137,650		314,262		69,200		74,500		137,650		312,040	
D)		79,200		79,200		106,686		419,768		73,440		73,440		106,686		389,668		66,500		66,500		109,061		339,648	(o)	64,888	(o)	64,888		89,221		317,890	
		78,100		44,400		57,010		419,404		74,400		43,700		59,010		416,921		79,400		72,000		101,260		458,286		77,800		74,200		101,435		439,237	
		118,020		118,020		238,300		416,724	(b)	113,000	(b)	113,000		239,100		389,103		104,000		104,000		238,100		365,929		97,200		97,200		166,500		339,369	
		91,100		90,700		97,468		415,944		84,100		83,800		98,508		356,725		68,800		66,900		97,668		311,106	(o)	61,200	(o)	58,600		98,688		294,871	
		99,900		99,900		97,130		415,862		97,500		90,400	(y)	90,630		333,564		205,000		197,000		227,130		439,485	(o)	139,700	(o)	139,700		227,100		484,269	
	(h)	.....		.....		113,500		414,328	(m)	84,445	(m)	83,295		113,500		388,871	(o)	75,346	(m)	74,570		88,500		343,762	(o)	77,716	(m)	76,300		88,500		381,249	
		80,100		80,100	(y)	120,000		384,392		74,900		74,900		120,000		347,127	(o)	71,600	(o)	71,600		120,000		304,348	(o)	68,500	(o)	68,500		120,000		296,238	
G. & E. Co.		78,105		75,485		94,266		376,385		76,300		73,430		90,195		347,846		72,510		69,365		88,265		329,252		70,100		68,750		86,265		326,457	
		115,000		117,000		140,400		374,616		90,000		90,000		86,400		151,770		.....		.....		.....		.....		.....		.....		.....		.....	
		71,229		.....		11,300		370,769		66,241		.....		11,300		332,958	(o)	59,401		.....		11,300		302,477	(o)	56,198		.....		11,300		304,740	
		81,000		81,000		113,750		355,866		78,000		78,000		113,750		344,227	(o)	72,000	(o)	72,000		113,750		319,772	(o)	68,000	(o)	68,000		82,500		308,008	
		71,500		27,000		35,480		350,886		71,700	(d)	66,000		35,480		306,432	(o)	52,800	(d, o)	49,800		35,480		253,631	(o)	48,600	(d, o)	46,500		55,000		244,549	
		70,590		69,390		79,600		348,568		70,800		66,760		80,200		311,603		58,505		57,405		80,200		277,041	(o)	66,700	(o)	66,600		80,200		301,486	
		77,500	(h)			49,340		336,591	(s)	42,500		.....		49,340		312,764		.....		.....		49,560		283,829		.....		.....		49,500		312,502	
		69,195		60,195		84,003		336,540		65,960		53,660		76,503		320,905		60,600		.....		75,943		297,919		60,820		50,255		76,183		287,744	
		66,100		65,300		89,000		335,809		63,500		63,400		89,000		305,033	(o)	59,200	(o)	59,200		89,000		305,724	(o)	57,500	(o)	57,300		66,000		319,946	
		78,330		73,330		124,944		333,705		73,250		70,100		126,444		313,592	(o)	68,250	(o)	66,400		127,369		268,618	(o)	62,905	(o)	60,805		107,009		278,351	
		79,200		79,200	(y)	117,700		326,779		85,100		85,100		117,700		305,819	(o)	69,000	(o)	69,000		117,700		284,482	(o)	59,700	(o)	59,700		117,700		299,760	
		87,800		80,600		99,000		325,960	(b)	72,600	(b)	72,500		99,000		264,027		64,550		62,500		99,000		248,639		59,800		56,800		74,000		235,657	
		62,595		23,960		31,967		321,883		59,490		.....		31,817		283,301	(o)	56,880		.....		31,817		279,592	(m)	54,550		.....		30,567		320,128	
		54,557		50,000		54,515		320,878		53,358		47,700		55,515		311,909	(o)	49,725		.....		59,265		305,528		49,762		34,100		44,265		296,354	
		64,430		57,100		99,241		312,567		63,700		57,000		99,241		291,687		59,600		52,000		99,436		265,968		55,000		48,500		76,580		272,179	
		63,800		43,600		37,500		304,848		53,400		39,200		37,500		255,017	(o)	45,000		.....		2,500		207,993	(o)	51,870		.....		2,500		264,098	
		60,100		7,750		16,384		293,135	(k)	57,860	(k)	10,720		17,384		272,027		51,840		400		22,384		224,805		47,390		7,500		23,384		227,974	
		55,700		55,700		98,820		288,943	(m)	54,300	(m)	54,300		93,220		268,237	(m)	51,800	(m)	51,800		93,220		262,896	(m)	57,400	(m)	57,400		143,420		310,102	
		55,933		53,840	(y)	52,082		286,415		54,750		49,650		52,442		274,473	(o)	51,650		.....		52,942		272,091		54,900		.....		53,162		293,348	
		57,971		54,100		98,500		282,916		57,673		57,600		99,400		260,411	(o)	56,372	(o)	56,300		99,400		244,164		59,629		53,729		99,000		231,222	
		58,900		53,000		58,824		264,860		60,900		54,300		58,824		226,405		52,100		41,000		58,754		181,886	(o)	43,100	(o)	42,100		58,567		180,210	
ystem		59,010		57,880		90,568		263,240		54,513		47,547		89,997		244,027	(o)	55,828	(o)	47,745		88,497		250,983		51,010		48,735		78,116		214,236	
		61,900		61,900		88,000		261,417		57,900		57,900		92,000		237,308		48,600		48,600		92,000		186,313	(o)	56,800	(o)	56,800		92,000		226,963	
		118,000		118,000		130,000		259,668		116,000		116,000		130,000		289,792		.....		.....		.....		.....		.....		.....		.....		.....	
		.....		57,325		107,400		259,617		.....		55,000		107,400		244,459		61,900		61,900		72,500		246,121		54,000		54,000		74,300		244,105	
		.....		54,500		54,000		253,559		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....	
		50,388	(h)		(y)	22,500		252,014		45,288		5,000		22,500		220,707	(o)	38,928	(o)	4,000		22,500		195,301	(o)	37,810	(o)	11,500		22,500		203,499	
		56,539		.....		14,608		250,892		51,600		4,700		15,170		239,128	(o)	59,755	(o)	7,268		15,170		240,306	(o)	49,459	(o)	5,560		15,968		219,639	
		58,706		.....		35,350		242,515		52,885		.....		35,350		232,342	(o)	52,759	(o)	21,230		35,350		196,378	(o)	54,488	(o)	33,560		35,350		214,399	
		48,000		30,900		31,000		236,077		47,200		28,100		31,000		198,243	(m)	42,600	(m)	22,600		31,000		165,343		46,100		24,000		31,000		201,481	
		54,200		51,485		45,800		235,105		51,575		51,575		45,800		240,854	(o)	51,200	(o)	51,200		45,800		237,574	(o)	51,560	(o)	51,560		45,800		267,172	
on		42,250		40,000		80,000		233,224		53,000		50,250		80,000		212,642		68,000		63,000		80,000		214,375	(x)	53,000	(x)	48,000		80,000	(x)	219,995	
		42,618		27,550	(X)	35,000		228,675		42,060		24,325		35,000		211,366		41,341		23,200		35,000		216,396	(o)	40,130	(o)	22,967		35,000		212,568	
		12,317		49,322		76,594		225,126		56,492		46,033		73,919		203,360		49,959		41,773		73,699		182,594		46,707		38,052		71,818		184,787	
		79,100		60,100		55,270		221,350		85,000		53,000		55,270		204,602		.....		.....		.....		.....		.....		.....		.....		.....	
	(k)	52,515	(k)	52,515		58,903		220,887		50,000		50,000		60,263		204,019		43,191		43,191		56,963		189,270		40,922		40,922		63,113		178,822	
		47,200		28,200		66,075		215,413		47,140		26,140		66,075		210,056		43,940		29,240		68,662		190,467	(o)	42,280	(o)	26,280		61,172		213,039	
		30,500		.....		21,797		214,186		.....		.....		22,541		185,843		.....		.....		.....		.....		.....		.....		.....		.....	
	(h)	40,600		.....		43,170		200,398		35,100		.....		42,170		181,780	(o)	31,600	(o)	26,700		41,370		160,707	(o)	29,000	(o)	29,000		41,732		163,881	
		40,666		.....		17,386		198,814		40,939		6,900		17,490		196,509	(o)	33,772	(o)	5,700		18,702		174,259	(o)	33,397	(o)	5,900		18,702		174,344	
		44,000		42,000		50,000		197,291		42,150		42,150		50,000		183,260		40,800		40,800		50,000		170,232		41,000		41,000		50,000		205,752	
		50,200		42,000		42,500		196,115		48,800		41,400		42,500		187,584		43,800		42,500		42,500		171,654		39,400		38,400		42,500		176,837	
		44,300		40,000		43,000		180,247		34,400		34,500		28,000		135,858	(o)	33,100	(o)	32,100		28,000		133,631		31,300		19,400		15,000		125,061	
		22,900		40,800		32,000		178,963		38,500		38,500		35,000		180,077		40,700		40,700		35,000		193,628	(o)	40,560	(o)	40,560		35,000		174,312	
		42,400		42,400		81,500		176,531	(m)	38,000		38,000		81,500		159,286		34,100		34,100		54,500		138,415		31,800		31,800		54,500		134,730	
	(m)	31,010	(m)	31,010		29,640		171,608	(m)	29,600	(m)	29,600		28,400		172,836	(m)	30,000	(m)	30,000		28,350		182,500		.....		.....		.....		.....	
es		33,800		33,800		69,000		169,913		32,600		32,600		69,000		155,988	(o)	30,500	(o)	30,500		69,000		147,814	(o)	29,400	(o)	29,400		39,000		144,708	
		39,100		39,100		62,800		168,752		34,000		34,000		62,800		149,787	(o)	33,500	(o)	33,500		67,800		130,435	(o)	35,500	(o)	35,500		50,900		143,260	
Comm'rs.		45,162		45,162		87,700		167,105		38,952		38,952		59,950		140,099		36,970		36,970		56,200		115,392		37,271		37,271		56,200		139,612	
		33,400		31,000		27,000		165,357		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....	
		39,500		34,080		47,500		164,916		37,105		31,640		47,335		155,764	(o)	35,990	(o)	31,280		47,335		146,723	(o)	34,200	(o)	28,180		45,450		144,924	
		51,300		49,900		49,991		164,351		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....	
		.....		37,000		68,500		162,964		.....		36,400		46,500		155,085		33,400		33,400		48,500		146,657	(m)	32,200	(m)	26,000		33,500		140,282	
		33,160		33,160		36,115		160,184		32,030		32,030		35,960		130,912		.....		26,660		33,460		125,652	(o)	24,460	(o)	24,460		31,035		136,455	
		33,100		33,100		56,649		157,325		32,000		32,000		56,529		143,289		28,900		28,900		56,529		135,757		26,600		26,600		56,529		127,294	
	(k)	35,687		.....		47,438		155,492	(k)	30,120		.....		47,438		133,080		25,950		.....		47,438		116,378		27,700		.....		47,438		128,607	
		61,800		61,800		131,838		153,372		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....	
		24,000		24,000		53,096		148,581		18,200		18,200		30,000		107,610		.....		.....		.....		.....		.....		.....		.....		.....	
		38,600		38,600		46,000		148,546		36,731		37,300		46,000		140,801		33,700		33,400		47,500		127,392	(o)	31,700	(o)	31,700		47,500		130,148	
		.....		19,200		27,000		146,631		.....		16,200		27,000		129,324		.....		.....		.....		.....		.....		.....		.....		.....	
		.....		43,200	(y)	.....		140,952		36,120		44,200		55,000		133,862	(o)	25,180	(o)	41,400		55,000		130,017	(o)	26,470	(o)	44,670		55,000		139,909	
		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....		.....	
119	Iowa Electric Light and Power Co.																																
120	Cumberland County Power and Light Co.			47,200		28,200		66,075		215,413		47,140		26,140		66,075		210,056		43,940		29,240		68,662		190,467	(o)	40,922	(o)	42,280	(o)	26,280	

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	12,317		49,322		76,394	225,126		36,492		48,693		75,919													118
	79,100		60,100		55,270	221,350		85,000		53,000		55,270		204,602											119
	(k) 52,515	(k)	52,515		58,903	220,887		50,000		50,000		60,263		204,019		43,191		43,191		56,963		189,270		40,922		40,922		63,113		178,822	120
	47,200		28,200		66,075	215,413		47,140		26,140		66,075		210,056		43,940		29,240		68,662		190,467	(o)	42,280	(o)	26,280		61,172		213,039	120
	30,500				21,797	214,186						22,541		185,843																121
	(h) 40,600				43,170	200,398		35,100				42,170		181,780	(o)	31,600	(o)	26,700		41,370		160,707	(o)	29,000	(o)	29,000		41,732		163,881	122
	40,666				17,386	198,814		40,939		6,900		17,490		196,509	(o)	33,772	(o)	5,700		18,702		174,259	(o)	33,397	(o)	5,900		18,702		174,344	123
	44,000		42,000		50,000	197,291		42,150		42,150		50,000		183,260		40,800		40,800		50,000		170,232		41,000		41,000		50,000		205,752	124
	50,200		42,000		42,500	196,115		48,800		41,400		42,500		187,584		43,800		42,500		42,500		171,654		39,400		38,400		42,500		176,837	125
	44,300		40,000		43,000	180,247		34,400		34,500		28,000		135,858	(o)	33,100	(o)	32,100		28,000		133,631		31,300		19,400		15,000		125,061	126
	22,900		40,800		32,000	178,963		38,500		38,500		35,000		180,077		40,700		40,700		35,000		193,628	(o)	40,560	(o)	40,560		35,000		174,312	127
	42,400		42,400		81,500	176,531	(m)	38,000		38,000		81,500		159,286		34,100		34,100		54,500		138,415		31,800		31,800		54,500		134,730	128
	(m) 31,010	(m)	31,010		29,640	171,608	(m)	29,600	(m)	29,600		28,400		172,836	(m)	30,000	(m)	30,000		28,350		182,500									129
	33,800		33,800		69,000	169,913		32,600		32,600		69,000		155,988	(o)	30,500	(o)	30,500		69,000		147,814	(o)	29,400	(o)	29,400		39,000		144,708	130
	39,100		39,100		62,800	168,752		34,000		34,000		62,800		149,787	(o)	33,500	(o)	33,500		67,800		130,435	(o)	35,500	(o)	35,500		50,900		143,260	131
	45,162		45,162		87,700	167,105		38,952		38,952		59,950		140,099		36,970		36,970		56,200		115,392		37,271		37,271		56,200		139,612	132
	33,400		31,000		27,000	165,357																									133
	39,500		34,080		47,500	164,916		37,105		31,640		47,335		155,764	(o)	35,990	(o)	31,280		47,335		146,723	(o)	34,200	(o)	28,180		45,450		144,924	134
	51,300		49,900		49,991	164,351																									135
			37,000		68,500	162,964				36,400		46,500		155,085		33,400		33,400		48,500		146,657	(m)	32,200	(m)	26,000		33,500		140,282	136
	33,160		33,160		36,115	160,184		32,030		32,030		35,960		130,912				26,660		33,460		125,652	(o)	24,460	(o)	24,460		31,035		136,455	137
	33,100		33,100		56,649	157,325		32,000		32,000		56,529		143,289		28,900		28,900		56,529		135,757		26,600		26,600		56,529		127,294	138
	(k) 35,687				47,438	155,492	(k)	30,120				47,438		133,080		25,950				47,438		116,378		27,700				47,438		128,607	139
	61,800		61,800		131,838	153,372																									140
	24,000		24,000		53,096	148,581		18,200		18,200		30,000		107,610																	141
	38,600		38,600		46,000	148,546		36,731		37,300		46,000		140,801		33,700		33,400		47,500		127,392	(o)	31,700	(o)	31,700		47,500		130,148	142
			19,200		27,000	146,631				16,200		27,000		129,324																	143
	27,320		42,900	(y)	55,000	140,953		26,140		44,200		55,000		133,862	(o)	25,180	(o)	41,400		55,000		130,017	(o)	26,470	(o)	44,670		55,000		139,909	144
	39,370		23,200		22,750	140,220		34,270		23,400		22,750		132,440		33,600		19,400		23,950		121,182	(o)	29,000	(o)	22,100		23,950		119,020	145
			31,400		31,250	128,530		31,500		31,500	(X)	31,250		112,693		31,500		31,500	(X)	31,250		157,156		31,500		31,500	(X)	31,250		128,970	146
	24,145		22,340		32,428	124,306		23,015		22,415		30,788		112,157	(o)	19,785	(o)	18,385		30,358		103,223	(o)	19,714		18,950		30,338		102,676	147
	28,000		14,850		25,107	123,633		26,700		16,600		25,107		118,406		26,700		15,000		25,107		113,299		23,000		15,000		25,107		118,064	148
	19,900		28,100		39,000	119,962		19,000		25,700		39,000		101,875																	149
	28,496		28,496		42,643	112,818		29,765		29,765		42,908		104,310																	150
	24,900		15,600		18,317	110,372																									151
	28,000		28,000		28,228	108,592		26,800		26,800		28,228		101,377																	152
			15,000		15,000	104,003																									153
	24,460		24,460		36,809	102,882																									154
	27,100		26,600		50,000	102,408																									155
	(b) 1,621,772	(b)	1,065,224		1,377,690	9,804,992	(b)	1,564,200		1,025,200		1,160,000		8,673,283		1,467,800		1,000,800		1,160,000		7,670,559		1,349,600		960,800		1,151,870		7,842,343	156
	897,170		649,500	(X)	876,000	5,899,605		892,415		640,300		701,372		5,923,888		925,980		666,390		693,594		5,409,657		906,260		670,260		689,687		5,875,289	157
	604,010		443,500		606,020	3,993,050		587,980				568,720		3,300,437		423,890		146,500		221,500		2,078,595		432,440		155,500		231,910		2,517,938	158
	525,149		524,299		541,358	3,078,092		519,617		518,767		541,658		3,008,799	(o)	479,273	(o)	478,423		541,358		2,693,150		494,310		493,460		513,671		3,023,365	159
	404,000		404,000		420,000	2,645,180		408,000		408,000		420,000		2,478,320		406,000		406,000		420,000		2,430,696		403,000		403,000		420,000		2,586,184	160
	201,000		201,000		200,000	1,631,294		196,000		196,000		200,000		1,479,644		196,000		196,000		200,000		1,291,709		200,000		200,000		200,000		1,486,071	161
	(b) 148,500	(b)	148,500	(X)	263,100	783,484	(b)	172,100	(b)	172,100	(X)	263,100		830,659		174,600		174,600	(X)	263,100		769,471		159,100		159,100	(X)	263,100		867,605	162
	105,200	(b)	68,300		94,375	742,830	(b)	104,300	(b)	70,300		94,375		749,904		99,100		67,100		94,375		700,849		91,300		64,300		94,375		649,123	163
			117,000		106,150	735,629																									164
	(m) 97,200		106,674		122,000	584,587		96,700		107,044		126,820		590,672		92,600		101,810		126,820		580,275		90,000		99,899		143,190		554,813	165
	121,400		121,400	(X)	228,825	537,674		117,000		117,000	(X)	228,825		504,689	(o)	118,600	(o)	118,600	(X)	228,825		490,132	(o)	113,800	(o)	113,800		184,825		488,160	166
					54,200	331,568						54,200		256,234						54,200		220,588						46,700		267,395	167
	51,800		44,200		43,865	240,772		50,400		45,000		43,865		250,875		50,600		44,800		43,865		229,254		49,200		44,600		43,865		247,781	168
	(b) 46,400	(b)	12,300		16,200	224,146	(b)	42,800	(b)	12,500	(X)	16,200		205,025		42,600		13,300		16,225		194,524									169
				(Z)	76,724	217,080					(Z)	76,168		244,400					(Z)	76,224		230,389					(Z)	67,362		219,096	170
	(m) 40,500	(m)	49,600	(X)	66,077	161,174	(s)	34,300	(s)	37,000		66,077		145,165	(s)	53,500	(m)	37,200		67,027		133,104	(m, s)	50,600	(m)	35,000	(X)	67,027		129,839	171
	20,000		18,000		27,000	108,355																									172
and Subs.	212,870		209,857		244,113	1,148,453		209,923		206,683		238,000		1,093,569	(o)	220,628	(o)	222,761		237,000		1,177,343	(o)	217,123	(o)	215,257		237,000		1,161,262	173
sit System*	568,000		568,000		610,000	2,300,027		113,269		0		0		454,048		111,351		0		0		390,968		103,840		0		0		375,135	174
	(L)		0		0	1,204,407	(L)			0		0		1,148,804	(L)			81,000		88,000		977,475	(o, L)			87,150		88,000		840,212	175
	186,176		0		0	591,545		186,176		0		0		589,565				0		0		590,420				0		0		658,057	176
	99,783		0		0	325,533		99,849		0		0		314,867		95,991		0		0		306,485		96,241		0		0		318,748	177
	72,973		0		0	253,862		67,660		0		0		243,466	(o)	74,322		0		0		236,258	(o)	71,025		0		0		240,716	178
	77,900		76,800		180,000	230,411		79,100		78,000		180,000		225,622		83,630		82,530		180,000		222,153		81,505		79,905		180,000		223,998	179
Co.	43,150		21,200		43,000	179,527		40,900		23,200		43,000		171,380	(o)	41,200	(o)	19,200		43,000		160,468	(o)	46,600	(o)	25,800		43,000		180,202	180
	37,600		28,800		41,885	140,197		30,000		25,000		42,955		131,973		45,000		26,500		43,555		116,226		48,000		28,000		43,855		137,716	181
			0		0	129,576	(b)	35,600		0		0		123,507		39,100		0		0		130,263		41,000		0		0		138,923	182
			34,000		40,000	120,869																									183
	36,800		0		0	117,352		37,200		0		0		124,985		40,100		0		0		130,510		45,000		0		0		146,219	184
	40,450		40,450		90,000	116,515		38,660		38,660		90,000		115,504	(o)	42,990	(o)	42,990		90,000		120,336	(o)	44,650	(o)	44,650		91,000		128,618	185
R.R. Co.			0		0	115,091				0		0		105,631				0		0		95,236				0		0		116,990	186

annual output of
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rsely, if it fails to
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worthy of special

Power Company
1940, is included

Public Utility District No. 1 of Cowlitz County, Wash., took over electric properties of Washington Gas & Electric Company on November 26, 1940.

In accordance with the city's unification of transit properties, Williamsburgh Power Plant Corporation (BMT) and the Interborough Rapid Transit Company (IRT) were transferred to the City of New York on June 1, 1940.

(a) Company practice varies as to the period for which peak loads are determined. Beginning with 1939, peak data have been requested on a 60-minute basis; previously — from 1931 to 1939 — they were asked for on a 30-minute basis. Those peaks reported for less than 30 minutes are noted, but no distinction has been made among estimated, observed or integrated values.

(b) Fifteen-minute (20-min. for Canadian utilities). Line 163 — 10-min.

(c) Peaks refer to Kansas City district only.

(d) Excluding purchases for surplus sales to other electric corporations, but including purchases to supplement output of generating stations for use of customers in Central Hudson territory.

(e) Excludes all energy supplied to Potomac Electric Power and The Pennsylvania Railroad.

(f) Columbus district only; 60-minute.

(g) Includes "firm peak service" to Potomac Electric Power; in 1937, 15,783,000 kw.-hr.; 1938, 13,821,000.

(h) Line 60 — Peaks are for company and affiliates, combined capacity, 145,161 kw. (73) Sum of peaks of two divisions: 1939 — Bridgeport, 54,300 kw., New Haven, 46,800; 1938 — 48,500 and 46,400; 1937 — 44,700 and 42,200. (82) Peoria-Springfield Div., 88,252 kw.; DeKalb Div., 7,000. (90) Non-coincident peaks: Stamford, 30,100 kw.; Falls Village, 10,600; Farmington Valley, 1,700. (110) Company's system load included in Philadelphia Electric report. (122) Company territorial peak.

(j) Instantaneous, includes station use.

(k) Thirty-minute.

(l) Not available, due to large number of plants, many of which are not interconnected.

(m) Instantaneous or five-minute.

(n) After deduction of 4,000 kw. station auxiliary service.

(o) Sixty-minute.

(r) Gross peak.

(s) Line 29 — Sum of five non-simultaneous system loads. In 1937, peak of interconnected system only. (90) Thirty-minute peaks on interconnected system. (171) Instantaneous peaks on interconnected system.

(v) Including Chelan Electric in 1938 and seven months of 1937.

(x) Fiscal year ending June 30, 1937.

(y) Line 5 — Includes Ohio Power's share of Windsor plant and 30,000 kw. allocated to West Penn Power. (49) Generating capability, 113,480 kw. (50) Capable capacity, 1940, 163,496 kw.; 1939, 164,696. (81) 72,500-kw. generator capacity limited by boiler capacity to 66,000. (83) Includes Atlantic City Electric's share of Deepwater plant. (94) Includes Scranton Electric's share of Stanton plant. (102) Effective capacity, 61,780 kw. (110) Actual plant capacity presently limited to 12,500 kw. (144) Limited to 47,000 kw. by boiler capacity.

(D) Includes subsidiary or affiliated companies. See Note (D) Table II.

(L) In 1940, PRR, 202,702 kw.; LIRR, 74,800. In 1939, PRR, 185,280; LIRR, 75,757. In 1938, PRR (o), 189,786; LIRR, 73,200. In 1937, PRR, 169,825; LIRR, 84,482. Not coincident.

(M) Mainland system.

(X) Kva.

(Z) Hp.

For explanation and comments relating to these statistics, the "Electrical World" of May 3, 1941, should be consulted.

Supplement to ELECTRICAL WORLD, May 3, 1941
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Table II—Detailed Data on Generator Rating, Output, Customers and Distribution of Energy of Public Utility Systems Having an Output Exceeding 100,000,000 Kw.-Hr. During 1940

Line No.	Section and System	Generator Rating, Dec. 31, 1940				Source of Energy, 1940, Thousands of Kw.-Hr.			Disposal of Energy in Thousands of Kw.-Hr.					Distribution of Sales to Ultimate Consumers in Thousands of Kilowatt-Hr.							Number of Customers, Dec. 31, 1940				
		Fuel Burning		Hydro												Commercial							Commercial		
		No. of Plants	Nameplate Rating of Generators, Kw.	No. of Plants	Nameplate Rating of Generators, Kw.	Generated, Net	Received by Purchase or Interchange, Net	Total Input, Net	Used by Electric Railway Dept.	Used by Electric and Other Depts.	Lost and Unaccounted For	To Other Public Utilities	Sales to Ultimate Consumers	Rural	Domestic	Small Light and Power (Retail)	Large Light and Power (Wholesale)	Municipal Street Light and Other Public	Railways and Electrified Railroads	Other Sales to Ultimate Consumers	Rural	Domestic	Small Light and Power	Large Light and Power	Other Ultimate Consumers
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
	New England States																								
1	New England Power Association (Consolidated) (*D*)	*u* 17	390,190	*u* 33	318,375	1,975,727	759,567	2,735,294	26,541	64,841	356,918	500,537	1,786,457	(*f*)	*f* 371,515	325,511	1,024,291	50,534	14,606	0	(*f*)	*f* 546,972	83,707	1,897	304
2	Boston Edison Co	2	388,860	2	300	1,423,387	188,055	1,611,442	0	13,765	186,714	480,155	930,808	0	264,500	205,469	415,076	33,553	12,210	0	0	*a* 345,054	*a* 71,165	*a* 871	*a* 115
3	The Connecticut Light and Power Co	2	130,000	8	64,145	695,609	173,878	869,487	0	9,523	114,103	121,998	623,863	(*f*)	*f* 168,486	*y* 65,126	360,960	* 11,287	18,004	0	(*f*)	*f* 153,271	*y* 18,496	1,791	78
4	The Hartford Electric Light Co	2	164,000	1	1,500	629,136	7,843	636,979	0	1,989	23,948	287,204	323,838	0	87,317	86,955	130,390	8,569	10,607	0	0	66,294	10,310	141	24
5	Central Maine Power Co	6	34,747	24	138,350	573,971	31,338	605,309	*H* 4,674	21,152	74,325	61,323	443,835	14,101	46,894	32,156	334,359	4,778	3,091	8,456	18,880	58,896	11,007	1,978	1,549
6	Western Massachusetts Cos (*D*)	3	79,100	7	99,875	335,303	178,356	513,659	0	7,966	72,769	72,973	359,951	(*f*)	*f* 74,846	56,825	213,348	8,762	4,638	*k* 1,532	(*f*)	*a*,*f* 82,046	*a* 13,251	*a* 1,838	*a* 44
7	Montaup Electric Co	1	75,000	0	0	475,790	6,917	482,707	0	0	0	482,707	0	0	0	0	0	0	0	0	0	0	0	0	0
8	The United Illuminating Co	2	160,000	0	0	475,864	0	475,864	0	0	52,241	13,448	410,175	0	91,178	82,797	228,077	8,123	0	0	0	118,151	16,578	2,160	15
9	The Connecticut Power Co	1	38,740	2	10,600	186,203	150,388	336,591	0	3,568	35,293	139,646	158,084	0	60,209	26,350	67,220	4,022	0	283	0	*a* 51,092	*a* 7,528	*a* 1,640	*a* 1
10	Public Service Co. of New Hampshire	5	63,450	31	61,494	319,517	14,188	333,705	1,852	6,566	45,662	72,917	206,708	(*f*)	*f* 50,400	25,956	121,188	5,212	14	3,938	(*f*)	*f* 63,631	8,855	848	1,013
11	New Bedford Gas and Edison Light Co	1	88,000	0	0	261,417	0	261,417	0	2,779	22,473	47,665	188,500	1,116	19,389	18,689	145,258	2,916	0	1,132	799	38,343	5,142	50	272
12	Blackstone Valley Gas & Electric Co	1	33,500	4	1,850	28,266	214,249	242,515	0	1,939	27,860	5,369	207,347	0	25,751	18,330	155,271	3,084	0	4,911	0	46,578	5,843	544	221
13	Cumberland County Power and Light Co	2	36,000	11	30,075	163,653	51,760	215,413	7,488	4,185	27,291	8,898	167,551	4,812	33,367	49,917	73,907	3,962	0	1,586	6,959	40,704	9,148	12	509
14	Rumford Falls Power Co	0	0	2	*n* 29,640	171,608	0	171,608	0	0	3,957	6,379	161,272	0	0	0	0	0	0	161,272	0	0	0	0	1
15	Bangor Hydro-Electric Co	0	0	12	36,115	160,100	84	160,184	2,481	1,174	23,629	22,225	110,675	0	21,455	14,686	72,651	1,883	0	0	0	25,509	5,351	948	77
16	Cambridge Electric Light Co	1	22,750	0	0	106,004	34,216	140,220	0	1,009	6,674	13,301	119,236	0	20,144	24,155	69,071	4,165	0	1,701	0	29,892	5,184	155	154
17	Lynn Gas and Electric Co	1	39,000	0	0	117,380	2,582	119,962	0	2,402	6,852	49,182	61,526	0	20,736	9,167	25,987	5,283	192	161	0	34,850	5,228	511	49
18	Central Vermont Public Service Corp	0	0	19	18,317	53,255	57,117	110,372	0	2,850	16,652	7,886	82,984	4,734	14,914	9,852	50,613	1,735	332	804	4,511	17,582	3,183	511	433
	Totals for section	47	1,743,337	156	810,636	8,152,190	1,870,538	10,022,728	43,036	145,708	1,097,361	2,393,813	6,342,810	24,763	1,371,101	1,051,941	3,487,667	157,868	63,694	185,776	31,149	1,718,865	279,976	15,895	4,859
	Middle Atlantic States																								
19	Niagara Hudson System (*D*)	6	664,850	88	991,814	7,342,139	1,441,020	8,783,159	2,942	80,384	844,005	1,169,132	6,686,696	*w* 60,120	603,541	648,681	5,066,068	83,941	62,569	161,776	45,939	604,721	82,424	2,450	6,902
20	Consolidated Edison Co. of N. Y. Inc. (*D*)	10	2,527,300	0	0	7,348,854	192,665	7,541,519	0	69,952	881,731	*l* 1	6,589,835	0	1,279,645	1,601,088	1,993,971	482,801	1,231,956	374	*a* 0	*a* 1,987,373	*a* 410,891	*a* 24,170	*a* 2,786
21	Philadelphia Electric Co. and Subs. (*D*)	8	872,360	3	253,765	4,963,986	−309,618	4,654,368	0	34,813	450,022	254,966	3,914,567	18,449	623,272	503,614	1,752,324	31,200	973,893	11,815	10,656	607,394	123,923	1,740	562
22	Public Service Electric and Gas Co	5	837,700	0	0	2,985,327	331,781	3,317,108	*h* 100,249	33,126	406,990	3,770	2,772,973	(*f*)	*f* 607,241	*f* 666,653	1,396,510	68,417	34,152	0	(*f*)	*f* 818,024	*f* 157,559	1,145	225
23	American Water Works and Electric Co., Inc. (*D*)	27	594,879	9	54,025	2,750,826	65,147	2,815,973	31,068	17,917	334,169	25,150	2,407,669	(*f*)	335,045	235,334	1,796,720	24,038	16,532	0	(*f*)	370,241	49,891	3,769	434
24	Duquesne Light Co	*u* 4	504,000	0	0	2,409,511	3,254	2,412,765	0	10,095	189,618	281	2,212,771	0	324,246	163,115	1,482,626	28,717	214,067	0	0	315,711	34,600	3,145	114
25	Pennsylvania Power & Light Co	16	346,812	20	44,877	1,543,067	421,101	1,964,168	0	4,936	228,697	14,016	1,716,519	42,603	241,783	192,771	1,132,597	21,994	31,610	53,161	35,888	323,292	48,759	3,032	2,843
26	Penn. W. & P. Co.— Safe Harbor W. P. Corp	1	20,000	2	321,000	1,526,351	*b* −5,220	1,521,131	0	0	*v* 58,982	1,286,874	175,275	0	0	0	0	0	175,275	0	0	0	0	0	1
27	New York State Electric & Gas Corp	9	100,153	21	22,960	548,029	493,499	1,041,528	0	5,450	135,189	148,905	751,984	*w* 36,587	179,922	164,514	306,333	24,634	465	39,529	*w* 30,234	202,441	29,644	1,541	4,337
28	Metropolitan Edison Co	3	169,000	4	21,928	629,986	188,733	818,719	0	9,576	94,543	102,845	611,755	26,412	77,227	50,727	433,225	6,933	8,945	8,286	18,487	90,884	13,699	2,244	855
29	Penn. Electric Co.— Subs. & Affil. (*D*)	6	95,961	2	48,000	533,760	1,826	535,586	0	5,885	93,622	40,920	395,159	6,188	79,406	73,273	230,150	4,124	1,820	198	6,643	109,246	15,129	1,560	153
30	Rochester Gas and Electric Corp	6	114,975	10	47,275	477,464	26,774	504,238	0	19,362	63,949	1,695	419,232	9,589	89,906	119,802	147,254	20,836	15,635	16,210	9,315	113,843	14,042	818	1,088
31	Jersey Central Power & Light Co	5	137,300	1	350	445,791	2,173	447,964	0	7,018	55,373	*l* 71,066	314,507	*w* 1,806	82,786	46,429	156,793	9,625	13,107	3,961	*w* 341	96,162	14,182	885	160
32	Long Island Lighting System	6	238,300	0	0	416,710	14	416,724	0	9,740	66,765	12,612	327,607	0	141,861	77,829	63,868	26,227	14,131	3,691	0	157,113	20,997	3,106	174
33	Atlantic City Electric Co	2	*m* 120,000	0	0	382,210	2,182	384,392	0	4,523	45,142	4,507	330,220	*w* 9,738	68,052	60,108	155,661	11,377	9,876	*k* 15,408	*w*,*a* 6,110	*a* 76,231	*a* 14,244	*a* 87	*a* 1,141
34	Central Hudson Gas & Electric Corp	1	12,000	5	23,480	91,191	259,695	350,886	0	8,737	39,524	53,025	249,600	*w* 14,985	55,100	41,947	130,013	7,555	0	0	*w* 6,650	60,946	11,671	146	84
35	Pennsylvania Edison Co	4	75,500	2	4,100	338,507	10,061	348,568	0	*H* 1,570	45,439	51,482	250,077	2,915	42,142	30,321	163,756	2,783	8,160	0	1,355	55,634	10,253	199	104
36	The Scranton Electric Co	3	*m* 117,700	0	0	322,191	4,588	326,779	0	1,956	25,572	27,424	271,827	*w* 901	52,725	35,526	164,324	4,657	9,979	*k* 3,715	*w*,*a* 958	*a* 72,966	*a* 9,450	*a* 286	*a* 426
37	Pennsylvania Power Co	2	37,500	0	0	258,760	46,088	304,848	0	0	29,087	8,524	267,237	0	48,481	33,415	181,027	3,091	1,223	0	0	46,239	5,697	79	34
38	New Jersey Power & Light Co	1	55,000	1	270	351,397	−130,047	221,350	*k* 65	1,668	29,207	8,718	181,692	(*f*)	*f* 45,124	16,156	103,825	3,681	7,367	5,539	(*f*)	*f* 47,662	5,852	705	677
39	Staten Island Edison Corp	1	46,000	0	0	137,913	10,633	148,546	0	*k* 2,566	17,582	0	128,398	0	35,959	19,177	40,165	7,316	16,422	9,359	0	41,933	6,282	127	499
40	Luzerne County Gas and Elec. Corp	2	*n* 55,000	0	0	212,030	−71,077	140,953	0	1,857	12,957	1,209	124,930	1,050	19,282	14,103	81,672	2,458	6,365	0	1,773	32,563	3,531	120	27
	Totals for section	128	7,742,290	168	1,833,844	36,016,000	2,985,272	39,001,272	134,324	331,131	4,148,165	3,287,122	31,100,530	231,343	5,032,746	4,794,583	16,978,882	876,405	2,853,549	333,022	174,349	6,230,619	1,082,720	51,354	23,626
	East North Central States																								
41	Commonwealth Edison Co. and Sub. Cos. (*D*)	14	2,091,000	5	8,000	8,109,075	11,769	8,120,844	0	(*v*)	*v* 938,923	1,074,821	6,107,100	50,564	1,115,442	834,196	2,957,976	234,716	914,206	0	32,336	1,198,008	160,474	4,965	609
42	American Gas and Electric Co. (Central System)	22	*m* 992,488	18	190,338	5,738,966	−61,107	5,677,859	0	33,549	575,231	671,733	4,397,346	*w* 63,379	495,041	328,706	3,379,197	32,384	8,964	*k* 89,675	*v*,*a* 56,659	*a* 538,582	*a* 82,060	*a* 2,419	*a* 6,307
43	The Detroit Edison Co	7	1,086,375	7	9,300	3,646,707	10,153	3,656,860	0	34,277	384,450	135,445	3,102,688	*w* 35,358	630,426	659,084	1,681,442	22,467	37,671	36,240	*w* 32,500	591,849	80,286	479	461
44	The Cleveland Elec. Illum. Co. (*A*)	4	523,750	0	0	2,076,235	6,632	2,082,867	0	9,411	232,370	31,724	1,809,362	0	289,397	223,008	1,074,389	17,473	152,506	52,589	0	293,331	39,731	836	1,463
45	Consumers Power Co	9	358,900	44	148,215	1,902,255	174,379	2,076,634	0	2,495	322,148	32,468	1,719,523	*s* 11,283	491,637	318,782	870,479	23,125	4,217	0	0	405,671	60,427	655	402
46	Columbia Gas & Elec. Corp. and Subs. (*D*)	5	541,750	0	0	1,776,146	−29,870	1,746,276	10,940	23,861	177,212	117,098	1,417,165	(*f*)	*f* 316,401	201,195	709,111	25,545	88,850	76,063	(*f*)	*f* 328,324	41,953	5,948	2,335
47	Wisconsin Elec. Power Co. and Affil. Cos. (*D*)	*u* 7	*n* 501,210	*u* 13	36,870	1,671,774	41,590	1,713,364	2,356	18,325	224,938	57,515	1,410,230	35,373	322,004	212,246	682,006	39,140	99,072	20,389	23,909	291,349	43,006	584	809
48	Ohio Edison Co	5	366,500	1	1,950	1,177,620	64,097	1,241,717	0	4,826	137,241	164,717	934,933	*s* 1,229	232,058	181,506	485,594	15,185	19,361	0	0	184,332	20,215	277	80
49	Public Service Co. of Indiana	6	129,230	2	4,290	762,753	152,021	914,774	0	6,280	128,085	302,982	477,427	12,526	82,877	70,155	227,945	10,252	57,335	*k* 16,337	12,409	114,242	21,282	2,449	1,957
50	Northern Indiana Public Service Co	3	96,100	9	19,355	405,972	468,438	874,410	0	12,687	90,604	143,856	627,263	11,708	60,266	38,729	464,518	6,698	31,185	14,159	8,629	76,518	11,961	1,896	1,133
51	The Ohio Public Service Co	5	*n* 104,117	0	0	559,707	184,240	743,947	583	3,595	74,300	71,475	593,994	16,569	78,310	64,267	427,244	7,604	0	0	15,022	79,497	12,472	356	39
52	The Toledo Edison Co	4	175,280	1	5,000	559,611	82,814	642,425	0	3,915	71,345	14,232	552,933	11,982	95,429	94,120	331,006	11,977	8,419	0	12,117	95,692	14,586	267	53
53	Central Illinois Public Service Co	3	100,000	0	0	296,626	270,521	567,147	0	20,691	93,499	68,321	384,636	10,426	87,794	61,942	202,655	10,003	0	11,816	7,923	131,378	27,142	4,372	488
54	Columbus and Southern Ohio Electric Co	6	181,350	0	0	487,464	9,383	496,847	23,071	3,859	68,613	23,365	377,939	8,882	98,794	101,346	151,264	2,999	0	14,654	13,427	119,682	17,515	989	1,105
55	Wisconsin Public Service Corp. and Sub. (*D*)	4	*n* 41,250	20	65,436	413,029	6,739	419,768	*k* 85	3,387	67,258	56,510	292,528	17,734	55,236	49,604	160,868	6,446	0	2,640	15,780	64,402	12,668	421	179
56	Central Illinois Light Co	4	113,500	0	0	411,026	3,302	414,328	0	1,796	40,154	14,372	358,006	*s* 200	73,416	64,371	214,877	5,142	0	0	0	65,521	9,322	193	34
57	Wisconsin P. & L. Co.— South Beloit W. G. & E. Co.	6	50,270	30	43,996	356,106	20,279	376,385	387	6,362	67,400	85,721	216,515	20,280	68,102	67,251	52,847	7,179	0	856	18,415	83,666	17,717	111	245
58	Northern Indiana Power Co	2	16,000	1	384	1,193	291,942	293,135	0	1,458	47,636	33,883	210,158	7,253	30,262	23,721	138,621	3,150	0	7,151	6,534	45,330	8,541	1,067	869
59	Indiana Service Corp	1	31,000	0	0	79,905	156,172	236,077	12,435	694	16,614	28,799	177,535	2,131	21,479	20,078	126,450	668	4,065	2,664	2,369	19,633	2,931	882	233
60	City of Detroit Public Lighting Commission	1	80,000	0	0	229,070	4,154	233,224	0	119,733	13,747	0	99,744	0	0	199	24,448	0	75,097	0	0	0	19	15	1
61	The Sanitary District of Chicago	0	0	1	*X* 35,000	74,907	153,768	228,675	0	925	4,491	0	223,259	0	0	*d* 798	(*d*)	*l* 122,725	0	*o* 99,736	0	0	*d* 9	(*d*)	5
62	City of Cleveland Dept. of Public Utilities	1	50,000	0	0	193,141	4,150	197,291	0	(*v*)	*v* 22,213	2,410	172,668	0	42,053	40,700	59,116	30,799	0	0	0	45,896	8,698	194	1
63	Southern Indiana Gas & Elec. Co	3	62,800	0	0	168,752	0	168,752	0	1,322	19,363	197	147,870	*s* 100	30,509	38,400	74,123	3,442	1,296	0	0	36,466	4,783	77	11
64	City of Lansing Bd. of Water & Elec. Lt. Commrs	2	86,500	2	1,200	166,800	305	167,105	0	640	8,390	0	158,075	0	39,440	33,912	80,182	4,541	0	0	0	26,235	3,367	59	2
65	Central Illinois Electric and Gas Co	4	46,238	1	1,200	102,295	53,197	155,492	619	6,108	16,667	0	132,098	3,180	32,624	24,910	60,680	3,901	0	6,803	2,748	38,542	5,349	559	355

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Table II—Detailed Data on Generator Rating, Output, Customers and Distribution of Energy of Public Utility Systems Having an Output Exceeding 100,000,000 Kw.-Hr. During 1940

This tabulation is based on the operating company as the unit. Group statistics are given in a few instances for properties which, though distinct corporate entities, are operated as a single physical system.

nd System	Generator Rating, Dec. 31, 1940: Fuel Burning No. of Plants	Fuel Burning Nameplate Rating of Generators, Kw.	Hydro No. of Plants	Hydro Nameplate Rating of Generators, Kw.	Source of Energy, 1940, Thousands of Kw.-Hr.: Generated, Net	Received by Purchase or Interchange, Net	Total Input, Net	Disposal of Energy in Thousands of Kw.-Hr.: Used by Electric Railway Dept.	Used by Electric and Other Depts.	Lost and Unaccounted For	To Other Public Utilities	Sales to Ultimate Consumers	Distribution of Sales to Ultimate Consumers in Thousands of Kilowatt-Hr.: Rural	Domestic	Commercial: Small Light and Power (Retail)	Commercial: Large Light and Power (Wholesale)	Municipal Street Light and Other Public	Railways and Electrified Railroads	Other Sales to Ultimate Consumers	Number of Customers, Dec. 31, 1940: Rural	Domestic	Commercial: Small Light and Power	Commercial: Large Light and Power	Other Ultimate Consumers	Total	Line No.
(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)
nd States																										
ation (Consolidated) (*D*)	*u* 17	390,190	*u* 33	318,375	1,975,727	759,567	2,735,294	26,541	64,841	356,918	500,537	1,786,457	(*f*)	*f* 371,515	325,511	1,024,291	50,534	14,606	0	(*f*)	*f* 546,972	83,707	1,897	304	632,880	1
	2	388,860	2	300	1,423,387	188,055	1,611,442	0	13,765	186,714	480,155	930,808	0	264,500	205,469	415,076	33,553	12,210	0	0	*a*345,054	*a* 71,165	*a* 871	*a* 115	*a*417,205	2
Power Co.	2	130,000	8	64,145	695,609	173,878	869,487	0	9,523	114,103	121,998	623,863	(*f*)	*f* 168,486	*y* 65,126	360,960	11,287	18,004	0	(*f*)	*f* 153,271	*y* 18,496	1,791	78	173,636	3
Co.	2	164,000	1	1,500	629,136	7,843	636,979	0	1,989	23,948	287,204	323,838	0	87,317	86,955	130,390	8,569	10,607	0	0	66,294	10,310	141	24	76,769	4
	6	34,747	24	138,350	573,971	31,338	605,309	*H* 4,674	21,152	74,325	61,323	443,835	14,101	46,894	32,156	334,359	4,778	3,091	8,456	18,880	58,896	11,007	1,978	1,549	92,310	5
(*D*)	3	79,100	7	99,875	335,303	178,356	513,659	0	7,966	72,769	72,973	359,951	(*f*)	*f* 74,846	56,825	213,348	8,762	4,638	*k* 1,532	(*f*)	*a,f* 82,046	*a* 13,251	*a* 1,838	*a* 44	*a* 97,179	6
	1	75,000	0	0	475,790	6,917	482,707	0	0	0	482,707	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
	2	160,000	0	0	475,864	0	475,864	0	0	52,241	13,448	410,175	0	91,178	82,797	228,077	8,123	0	0	0	118,151	16,578	2,160	15	136,904	8
	1	38,740	2	10,600	186,203	150,388	336,591	0	3,568	35,293	139,646	158,084	0	60,209	26,350	67,220	4,022	0	283	0	*a* 51,092	*a* 7,528	*a* 1,640	*a* 1	*a* 60,261	9
Hampshire	5	63,450	31	61,494	319,517	14,188	333,705	1,852	6,566	45,662	72,917	206,708	(*f*)	*f* 50,400	25,956	121,188	5,212	14	3,938	(*f*)	*f* 63,631	8,855	848	1,013	74,347	10
on Light Co.	1	88,000	0	0	261,417	0	261,417	0	2,779	22,473	47,665	188,500	1,116	19,389	18,689	145,258	2,916	0	1,132	799	38,343	5,142	50	272	44,606	11
lectric Co.	1	33,500	4	1,850	28,266	214,249	242,515	0	1,939	27,860	5,369	207,347	0	25,751	18,330	155,271	3,084	0	4,911	0	46,578	5,843	544	221	53,186	12
and Light Co.	2	36,000	11	30,075	163,653	51,760	215,413	7,488	4,185	27,291	8,898	167,551	4,812	33,367	49,917	73,907	3,962	0	1,586	6,959	40,704	9,148	12	509	57,332	13
	0	0	2	*n* 29,640	171,608	0	171,608	0	0	3,957	6,379	161,272	0	0	0	0	0	0	161,272	0	0	0	0	1	1	14
	0	0	12	36,115	160,100	84	160,184	2,481	1,174	23,629	22,225	110,675	0	21,455	14,686	72,651	1,883	0	0	0	25,509	5,351	948	77	31,885	15
o.	1	22,750	0	0	106,004	34,216	140,220	0	1,009	6,674	13,301	119,236	0	20,144	24,155	69,071	4,165	0	1,701	0	29,892	5,184	155	154	35,385	16
	1	39,000	0	0	117,380	2,582	119,962	0	2,402	6,852	49,182	61,526	0	20,736	9,167	25,987	5,283	192	161	0	34,850	5,228	511	49	40,638	17
vice Corp.	0	0	19	18,317	53,255	57,117	110,372	0	2,850	16,652	7,886	82,984	4,734	14,914	9,852	50,613	1,735	332	804	4,511	17,582	3,183	511	433	26,220	18
	47	1,743,337	156	810,636	8,152,190	1,870,538	10,022,728	43,036	145,708	1,097,361	2,393,813	6,342,810	24,763	1,371,101	1,051,941	3,487,667	157,868	63,694	185,776	31,149	1,718,865	279,976	15,895	4,859	2,050,744	
ntic States																										
	6	664,850	88	991,814	7,342,139	1,441,020	8,783,159	2,942	80,384	844,005	1,169,132	6,686,696	*w* 60,120	603,541	648,681	5,066,068	83,941	62,569	161,776	45,939	604,721	82,424	2,450	6,902	742,436	19
N. Y. Inc. (*D*)	10	2,527,300	0	0	7,348,854	192,665	7,541,519	0	69,952	881,731	*l* 1	6,589,835	0	1,279,645	1,601,088	1,993,971	482,801	1,231,956	374	*a* 0	*a*1,987,373	*a*410,891	*a* 24,170	*a* 2,786	*a*2,425,220	20
d Subs. (*D*)	8	872,360	3	253,765	4,963,986	−309,618	4,654,368	0	34,813	450,022	254,966	3,914,567	18,449	623,272	503,614	1,752,324	31,200	973,893	11,815	10,656	607,394	123,923	1,740	562	744,275	21
Gas Co	5	837,700	0	0	2,985,327	331,781	3,317,108	*h* 100,249	33,126	406,990	3,770	2,772,973	(*f*)	*f* 607,241	*f* 666,653	1,396,510	68,417	34,152	0	(*f*)	*f* 818,024	*f* 157,559	1,145	225	976,953	22
Electric Co., Inc. (*D*)	27	594,879	9	54,025	2,750,826	65,147	2,815,973	31,068	17,917	334,169	25,150	2,407,669	(*f*)	335,045	235,334	1,796,720	24,038	16,532	0	(*f*)	370,241	49,891	3,769	434	424,335	23
	u 4	504,000	0	0	2,409,511	3,254	2,412,765	0	10,095	189,618	281	2,212,771	0	324,246	163,115	1,482,626	28,717	214,067	0	0	315,711	34,600	3,145	114	353,570	24
t Co.	16	346,812	20	44,877	1,543,067	421,101	1,964,168	0	4,936	228,697	14,016	1,716,519	42,603	241,783	192,771	1,132,597	21,994	31,610	53,161	35,888	323,292	48,759	3,032	2,843	413,814	25
Harbor W. P. Corp.	1	20,000	2	321,000	1,526,351	*b* −5,220	1,521,131	0	0	*v* 58,982	1,286,874	175,275	0	0	0	0	0	175,275	0	0	0	0	0	1	1	26
Gas Corp.	9	100,153	21	22,960	548,029	493,499	1,041,528	0	5,450	135,189	148,905	751,984	*w* 36,587	179,922	164,514	306,333	24,634	465	39,529	*w* 30,234	202,441	29,644	1,541	4,337	268,197	27
	3	169,000	4	21,928	629,986	188,733	818,719	0	9,576	94,543	102,845	611,755	26,412	77,227	50,727	433,225	6,933	8,945	8,286	18,487	90,884	13,699	2,244	855	126,169	28
& Affil. (*D*)	6	95,961	2	48,000	533,760	1,826	535,586	0	5,885	93,622	40,920	395,159	6,188	79,406	73,273	230,150	4,124	1,820	198	6,643	109,246	15,129	1,560	153	132,731	29
Corp.	6	114,975	10	47,275	477,464	26,774	504,238	0	19,362	63,949	1,695	419,232	9,589	89,906	119,802	147,254	20,836	15,635	16,210	9,315	113,843	14,042	818	1,088	139,106	30
ht Co.	5	137,300	1	350	445,791	2,173	447,964	0	7,018	55,373	*l* 71,066	314,507	*w* 1,806	82,786	46,429	156,793	9,625	13,107	3,961	*w* 341	96,162	14,182	885	160	111,730	31
n.	6	238,300	0	0	416,710	14	416,724	0	9,740	66,765	12,612	327,607	0	141,861	77,829	63,868	26,227	14,131	3,691	0	157,113	20,997	3,106	174	181,390	32
	2	*m* 120,000	0	0	382,210	2,182	384,392	0	4,523	45,142	4,507	330,220	*w* 9,738	68,052	60,108	155,661	11,377	9,876	*k* 15,408	*w,a* 6,110	*a* 76,231	*a* 14,244	*a* 87	*a* 1,141	*a* 97,813	33
tric Corp.	1	12,000	5	23,480	91,191	259,695	350,886	0	8,737	39,524	53,025	249,600	*w* 14,985	55,100	41,947	130,013	7,555	0	0	*w* 6,650	60,946	11,671	146	84	79,497	34
	4	75,500	2	4,100	338,507	10,061	348,568	0	*H* 1,570	45,439	51,482	250,077	*w* 2,915	42,142	30,321	163,756	2,783	8,160	0	1,355	55,634	10,253	199	104	67,545	35
	3	*m* 117,700	0	0	322,191	4,588	326,779	0	1,956	25,572	27,424	271,827	*w* 901	52,725	35,526	164,324	4,657	9,979	*k* 3,715	*w,a* 958	*a* 72,966	*a* 9,450	*a* 286	*a* 426	*a* 84,086	36
	2	37,500	0	0	258,760	46,088	304,848	0	0	29,087	8,524	267,237	0	48,481	33,415	181,027	3,091	1,223	0	0	46,239	5,697	79	34	52,049	37
Co.	1	55,000	1	270	351,397	−130,047	221,350	*k* 65	1,668	29,207	8,718	181,692	(*f*)	*f* 45,124	16,156	103,825	3,681	7,367	5,539	(*f*)	*f* 47,662	5,852	705	677	54,896	38
	1	46,000	0	0	137,913	10,633	148,546	0	*k* 2,566	17,582	0	128,398	0	35,959	19,177	40,165	7,316	16,422	9,359	0	41,933	6,282	127	499	48,841	39
ec. Corp.	2	*n* 55,000	0	0	212,030	−71,077	140,953	0	1,857	12,957	1,209	124,930	1,050	19,282	14,103	81,672	2,458	6,365	0	1,773	32,563	3,531	120	27	38,014	40
	128	7,742,290	168	1,833,844	36,016,000	2,985,272	39,001,272	134,324	331,131	4,148,165	3,287,122	31,100,530	231,343	5,032,746	4,794,583	16,978,882	876,405	2,853,549	333,022	174,349	6,230,619	1,082,720	51,354	23,626	7,562,668	
entral States																										
and Sub. Cos. (*D*)	14	2,091,000	5	8,000	8,109,075	11,769	8,120,844	0	(*v*)	*v* 938,923	1,074,821	6,107,100	50,564	1,115,442	834,196	2,957,976	234,716	914,206	0	32,336	1,198,008	160,474	4,965	609	1,396,392	41
Co. (Central System)	22	*m* 992,488	18	190,338	5,738,966	−61,107	5,677,859	0	33,549	575,231	671,733	4,397,346	*w* 63,379	495,041	328,706	3,379,197	32,384	8,964	*k* 89,675	*v,a*56,659	*a*538,582	*a* 82,060	*a* 2,419	*a* 6,307	*a*686,027	42
	7	1,086,375	7	9,300	3,646,707	10,153	3,656,860	0	34,277	384,450	135,445	3,102,688	*w* 35,358	630,426	659,084	1,681,442	22,467	37,671	36,240	*w* 32,500	591,849	80,286	479	461	705,575	43
Co. (*A*)	4	523,750	0	0	2,076,235	6,632	2,082,867	0	9,411	232,370	31,724	1,809,362	0	289,397	223,008	1,074,389	17,473	152,506	52,589	0	293,331	39,731	836	1,463	335,361	44
	9	358,900	44	148,215	1,902,255	174,379	2,076,634	0	2,495	322,148	32,468	1,719,523	*s* 11,283	491,637	318,782	870,479	23,125	4,217	0	0	405,671	60,427	655	402	467,155	45
and Subs. (*D*)	5	541,750	0	0	1,776,146	−29,870	1,746,276	10,940	23,861	177,212	117,098	1,417,165	(*f*)	*f* 316,401	201,195	709,111	25,545	88,850	76,063	(*f*)	*f* 328,324	41,953	5,948	2,335	378,560	46
nd Affil. Cos. (*D*)	*u* 7	*n* 501,210	*u* 13	36,870	1,671,774	41,590	1,713,364	2,356	18,325	224,938	57,515	1,410,230	35,373	322,004	212,246	682,006	39,140	99,072	20,389	23,909	291,349	43,006	584	809	359,657	47
	5	366,500	1	1,950	1,177,620	64,097	1,241,717	0	4,826	137,241	164,717	934,933	*s* 1,229	232,058	181,506	485,594	15,185	19,361	0	0	184,332	20,215	277	80	204,904	48
a	6	129,230	2	4,290	762,753	152,021	914,774	0	6,280	128,085	302,982	477,427	12,526	82,877	70,155	227,945	10,252	57,335	*k* 16,337	12,409	114,242	21,282	2,449	1,957	152,339	49
rvice Co	3	96,100	9	19,355	405,972	468,438	874,410	0	12,687	90,604	143,856	627,263	11,708	60,266	38,729	464,518	6,698	31,185	14,159	8,629	76,518	11,961	1,896	1,133	100,137	50
	5	*n* 104,117	0	0	559,707	184,240	743,947	583	3,595	74,300	71,475	593,994	16,569	78,310	64,267	427,244	7,604	0	0	15,022	79,497	12,472	356	39	107,386	51
	4	175,280	1	5,000	559,611	82,814	642,425	0	3,915	71,345	14,232	552,933	11,982	95,429	94,120	331,006	11,977	8,419	0	12,117	95,692	14,586	267	53	122,715	52
re Co.	3	100,000	0	0	296,626	270,521	567,147	0	20,691	93,499	68,321	384,636	10,426	87,794	61,942	202,655	10,003	0	11,816	7,923	131,378	27,142	4,372	488	171,303	53
o Electric Co.	6	181,350	0	0	487,464	9,383	496,847	23,071	3,859	68,613	23,365	377,939	8,882	98,794	101,346	151,264	2,999	0	14,654	13,427	119,682	17,515	989	1,105	152,718	54
rp. and Sub. (*D*)	4	*n* 41,250	20	65,436	413,029	6,739	419,768	*k* 85	3,387	67,258	56,510	292,528	17,734	55,236	49,604	160,868	6,446	0	2,640	15,780	64,402	12,668	421	179	93,450	55
	4	113,500	0	0	411,026	3,302	414,328	0	1,796	40,154	14,372	358,006	*s* 200	73,416	64,371	214,877	5,142	0	0	0	65,521	9,322	193	34	75,070	56
uth Beloit W. G. & E. Co.	6	50,270	30	43,996	356,106	20,279	376,385	387	6,362	67,400	85,721	216,515	20,280	68,102	67,251	52,847	7,179	0	0	45,896	8,698	194	1	54,789	57
	2	16,000	1	384	1,193	291,942	293,135	0	1,458	47,636	33,883	210,158	7,253	30,262	23,721	138,621	3,150	0	7,151	6,534	45,330	8,541	1,067	869	62,341	58
	1	31,000	0	0	79,905	156,172	236,077	12,435	694	16,614	28,799	177,535	2,131	21,479	20,078	126,450	668	4,065	2,664	2,369	19,633	2,931	882	233	26,048	59
ng Commission	1	80,000	0	0	229,070	4,154	233,224	0	119,733	13,747	0	99,744	0	0	199	24,448	0	75,097	0	0	0	19	15	1	35	60
cago	0	0	1	*X* 35,000	74,907	153,768	228,675	0	925	4,491	0	223,259	0	0	*d* 798	(*d*)	*l* 122,725	0	*o* 99,736	0	0	*d* 9	(*d*)	5	14	61
Public Utilities	1	50,000	0	0	193,141	4,150	197,291	0	(*v*)	*v* 22,213	2,410	172,668	0	42,053	40,700	59,116	30,799	0	0	0	45,896	8,698	194	1	54,789	62
c. Co.	3	62,800	0	0	168,752	0	168,752	0	1,322	19,363	197	147,870	*s* 100	30,509	38,400	74,123	3,442	1,296	0	0	36,466	4,783	77	11	41,337	63
t & Elec. Lt. Commrs.	2	86,500	2	1,200	166,800	305	167,105	0	640	8,390	0	158,075	0	39,440	33,912	80,182	4,541	0	0	0	26,235	3,367	59	2	29,663	64
Gas Co.	4	46,238	1	1,200	102,295	53,197	155,492	619	6,108	16,667	0	132,098	3,180	32,624	24,910	60,680	3,901	0	6,803	3,748	38,543	5,340	550			65
57	Wisconsin P. & L. Co.— South Beloit W. G. & E. Co.	6	50,270	30	43,996	356,106	20,279	376,385	387	6,362	67,400	85,721	216,515	20,280	68,102	67,251	52,847	7,179	0	45,896	18,415	83,666	17,717	111	245	

NOTES

(1) In a number of instances, reports indicated that the allocations of energy and customers were estimated. To avoid additional notes, estimated quantities have not been specially marked.

(2) Where companies do not classify sales under the exact heads used in this table, items reported have been entered under the most nearly appropriate caption. For instance, it was impracticable to distinguish among residential, urban and domestic.

a Line 2—Bills rendered in December. (6) Bills rendered. (9, 67) Meters. (20, 73) Average number bills rendered. (33, 36, 42) Number of customer accounts. (75, 92, 137) Average number of customers.

b Interchange sold, 87,684; purchased, 82,464.

d Retail combined with wholesale.

f Farm or rural combined with other classification.

g Duke Power, Hydro-Electric Power Comm. of Ontario, Abitibi Power & Paper not included because of lack of data.

k Transferred to affiliated transportation company.

k Line 6—Exchanged for water power. (33, 36, 42, 49, 105, 106, 132, 146, 153) Other public authorities. (38, 39, 91, 112,130,151) Includes free service (franchise requirements, etc.). (55) Railway system abandoned in January, 1940. (92) Discontinued October, 1940. (113) Includes 1,140 free service.

l Line 20—Other electric utility. (31) Includes 63,078 interchange. (61) Some miscellaneous power and light. (92) Includes other government. (115) All government and municipal uses. (159) Municipal power. (168) Station service.

m Includes companies' share of: Line 33—Deepwater plant (35) Stanton; (42) Ohio Power share of Windsor and 30,000 kw. allocated to West

57	Wisconsin P. & L. Co.— South Beloit W. G. & E. Co.	6	50,270	30	43,996	356,106	20,279	376,385	387	6,362	67,400	85,721	216,515	20,280	68,102	67,251	52,847	7,179	0	856	18,415	83,666	17,717	111	245
58	Northern Indiana Power Co	2	16,000	1	384	1,193	291,942	293,135	0	1,458	47,636	33,883	210,158	7,253	30,262	23,721	138,621	3,150	0	7,151	6,534	45,330	8,541	1,067	869
59	Indiana Service Corp	1	31,000	0	0	79,905	156,172	236,077	12,435	694	16,614	28,799	177,535	2,131	21,479	20,078	126,450	668	4,065	2,664	2,369	19,633	2,931	882	233
60	City of Detroit Public Lighting Commission	1	80,000	0	0	229,070	4,154	233,224	0	119,733	13,747	0	99,744	0	0	199	24,448	0	75,097	0	0	0	19	15	1
61	The Sanitary District of Chicago	0	0	1	X 35,000	74,907	153,768	228,675	0	925	4,491	0	223,259	0	0	d 798	(d)	l 122,725	0	o 99,736	0	0	d 9	(d)	5
62	City of Cleveland Dept. of Public Utilities	1	50,000	0	0	193,141	4,150	197,291	0	(v)	v 22,213	2,410	172,668	0	42,053	40,700	59,116	30,799	0	0	0	45,896	8,698	194	1
63	Southern Indiana Gas & Elec. Co	3	62,800	0	0	168,752	0	168,752	0	1,322	19,363	197	147,870	s 100	30,509	38,400	74,123	3,442	1,296	0	0	36,466	4,783	77	11
64	City of Lansing Bd. of Water & Elec. Lt. Commrs	2	86,500	2	1,200	166,800	305	167,105	0	640	8,390	0	158,075	0	39,440	33,912	80,182	4,541	0	0	0	26,235	3,367	59	2
65	Central Illinois Electric and Gas Co	4	46,238	1	1,200	102,295	53,197	155,492	619	6,108	16,667	0	132,098	3,180	32,624	24,910	60,680	3,901	0	6,803	2,748	38,542	5,349	559	355
66	The Marion-Reserve Power Co	1	27,000	0	0	70,229	76,402	146,631	0	622	16,211	20,204	109,594	10,440	19,327	15,144	58,916	2,418	0	3,349	12,305	25,490	5,318	862	613
67	Lake Superior District Power Co	3	16,490	9	15,938	113,414	10,892	124,306	0	664	16,797	2,390	104,455	1,888	15,676	12,341	70,537	1,868	0	2,145	a 2,266	a 16,544	a 4,260	a 44	a 267
68	Madison Gas and Elec. Co	1	50,000	0	0	78,120	24,288	102,408	0	1,469	9,239	33	91,667	9,413	26,701	33,306	11,505	2,066	0	8,676	4,270	18,223	3,240	98	15
	Totals for section	133	7,919,148	164	586,472	31,628,898	2,190,650	33,819,548	50,476	322,951	3,885,139	3,154,271	26,406,711	341,898	4,850,701	3,814,017	14,777,996	653,913	1,502,244	465,942	279,618	4,934,403	719,332	31,074	20,071
	West North Central States																								
69	Union Electric Co. of Missouri and Subs. (D)	5	474,420	2	237,000	2,749,478	38	2,749,516	1,352	14,120	312,829	451,925	1,969,290	19,419	318,686	248,397	1,203,557	33,588	129,576	16,067	17,163	299,018	39,451	407	132
70	Northern States Pwr. Co. (Minn.) & Subs. (D)	21	344,826	u 27	u 147,495	1,494,193	77,818	1,572,011	0	13,074	223,446	87,549	1,247,942	13,563	406,530	260,638	473,716	31,380	4,079	58,036	9,528	339,963	48,138	20,683	917
71	Kansas City Power & Light Co	5	273,211	0	0	805,884	2,320	808,204	0	8,788	72,663	50,743	676,010	8,280	131,170	162,731	238,210	13,394	83,692	38,533	6,756	127,546	24,748	214	1,197
72	Minnesota Power & Light Co	5	30,270	11	94,911	493,126	566	493,692	0	2,021	69,754	63,873	358,044	3,099	40,670	43,141	253,462	3,212	5,761	8,699	(P)	(P)	(P)	(P)	(P)52,134
73	Nebraska Power Co	T 3	T 111,750	0	0	437,446	17,417	454,863	0	2,417	39,458	39,900	373,088	9,265	74,711	(d)	d 221,037	9,046	26,312	32,717	a 5,573	a 73,350	(d,a)	d,a 11,031	a 600
74	Kansas Gas and Electric Co	3	89,000	0	0	335,763	46	335,809	0	2,216	45,463	18,368	269,762	6,061	50,932	50,453	151,272	2,906	633	7,505	5,456	59,554	7,913	865	786
75	The Empire District Electric Co	1	71,500	4	27,320	291,884	−2,941	288,943	0	1,286	57,720	74,080	155,857	3,464	14,391	15,656	118,281	1,935	30	2,100	a 3,608	a 21,893	a 5,003	a 520	a 71
76	Sioux City G. & E. Co.— Iowa P. S. Co. System	21	88,517	4	2,051	256,255	6,985	263,240	0	5,264	36,254	18,782	202,940	6,182	52,124	d 120,745	(d)	6,940	7,489	9,460	7,485	68,406	d 17,083	(d)	304
77	Des Moines Electric Light Co. (D)	2	107,000	1	400	259,617	0	259,617	0	1,200	37,980	20,615	199,822	4,302	50,892	35,816	92,379	6,277	0	10,156	3,568	54,166	8,832	174	471
78	Interstate Power Co. (Del.) and Subs. (D)	24	69,459	13	7,135	186,836	38,290	225,126	0	1,712	37,931	36,113	149,370	5,585	49,310	54,504	27,217	5,945	532	6,277	4,466	61,575	17,873	59	416
79	Iowa Electric Light & Power Co	8	57,503	2	1,400	219,729	1,158	220,887	4,010	2,274	23,888	38,740	151,975	5,614	36,331	19,930	87,052	3,048	0	0	5,104	42,550	7,933	2,021	92
80	Kansas City, Kansas, Board of Public Utilities	1	69,000	0	0	169,913	0	169,913	0	o 15,063	14,420	0	140,430	0	30,025	21,635	84,739	3,280	751	0	0	29,763	4,041	66	2
81	Iowa-Nebraska Light and Power Co	15	45,265	5	2,235	126,049	38,867	164,916	0	2,741	22,289	16,014	123,872	3,637	38,369	40,601	32,791	2,894	984	4,596	3,373	48,666	11,589	61	310
82	Laclede Power & Light Co	3	68,500	0	0	162,882	82	162,964	0	49	22,623	14	140,278	0	31,835	16,132	92,311	0	0	0	0	33,840	4,013	992	0
83	Nebraska Public Power System	n 1	n 3,000	u 6	u 127,838	126,608	26,764	153,372	0	2,481	25,315	125,576	0	0	0	0	0	0	0	0	0	0	0	0	0
84	Iowa Southern Utilities Co	5	25,107	0	0	73,908	49,725	123,633	371	508	22,149	8,981	91,624	2,895	30,081	25,155	30,341	2,726	0	426	3,248	42,343	9,998	386	177
85	Otter Tail Power Co	7	37,713	5	4,930	112,779	39	112,818	0	404	25,505	18,911	67,998	1,081	28,677	24,660	9,164	2,288	0	2,128	1,317	29,703	10,796	28	516
	Totals for section	130	1,966,041	80	652,715	8,302,350	257,174	8,559,524	5,733	75,618	1,089,687	1,070,184	6,318,302	92,447	1,384,734	1,140,194	3,115,529	128,859	259,839	196,700	76,645	1,332,336	217,411	37,507	58,125
	South Atlantic States																								
86	Duke Power Co. (g)					O 2,686,739	368,023	3,054,762																	
87	Georgia Power Co	19	94,439	22	287,500	1,362,696	860,143	2,222,839	54,574	11,841	377,466	165,137	1,613,821	0	283,255	279,524	1,030,975	19,002	1,065	0	0	191,825	40,553	524	410
88	Cons. Gas Electric Light & Power Co., Baltimore	4	273,450	0	0	877,528	1,041,127	1,918,655	0	e 3,131	x 157,110	x 5,847	1,752,567	(w)	221,218	264,505	928,815	15,830	301,776	s 20,423	(w)	256,942	41,420	227	27
89	Carolina Power & Light Co	2	43,000	10	206,050	840,835	345,728	1,186,563	0	2,513	207,182	115,940	860,928	28,531	102,998	75,542	618,698	8,294	0	26,865	24,867	75,571	15,776	1,103	1,910
90	Potomac Electric Power Co	2	305,000	0	0	1,149,713	−59,010	1,090,703	0	6,661	121,485	18,175	944,382	(f)	f 218,689	240,483	365,525	27,047	92,638	0	(f)	f 176,626	27,704	391	41
91	Virginia Electric & Power Co	2	181,000	8	32,635	977,739	−98,693	879,046	34,163	k 8,451	106,829	31,236	698,367	(f)	f 165,497	172,026	327,899	4,253	0	28,692	(f)	f 142,246	25,909	405	1,133
92	Florida Power & Light Co	35	163,593	0	0	481,378	2,289	483,667	0	o 5,653	84,789	185	393,040	27,607	149,367	133,064	46,450	l 33,987	k 2,565	0	a 11,498	a107,369	a 23,056	a 862	a 1,607
93	Virginia Public Service Co	8	83,402	9	14,066	403,320	12,624	415,944	4,027	5,970	65,455	15,836	324,656	11,568	87,533	60,592	141,787	5,124	0	18,052	8,208	90,441	14,894	619	202
94	South Carolina Electric & Gas Co	1	n 72,500	2	24,630	386,573	29,289	415,862	0	5,453	39,748	202,219	168,442	w 2,225	18,327	24,946	117,483	1,463	0	3,998	w 1,848	18,146	5,057	242	115
95	Florida Power Corp	5	44,631	3	14,193	244,980	19,880	264,860	0	2,499	59,814	119,025	83,522	0	37,869	25,715	14,807	792	0	4,339	0	34,945	6,990	226	554
96	Lexington Water Power Co	0	0	1	130,000	132,784	126,884	259,668	0	9	4,644	255,015	0	0	0	0	0	0	0	0	0	0	0	0	0
97	Delaware Power & Light Co	1	T 22,500	0	0	59	251,955	252,014	0	1,505	16,370	13,412	220,727	594	36,519	y 48,672	z 120,115	2,879	11,448	500	430	35,963	y 6,903	z 196	25
98	South Carolina Power Co	3	19,570	1	23,600	136,806	63,592	200,398	0	1,118	27,139	26,336	145,805	0	38,604	27,493	77,531	2,177	0	0	0	25,995	6,865	109	45
99	Tampa Electric Co	2	42,500	0	0	191,162	4,953	196,115	8,027	3,190	26,253	7	158,638	2,401	30,892	24,960	94,766	2,469	0	3,150	1,716	38,331	6,485	74	322
100	Jacksonville Municipal Light Plant	1	81,500	0	0	176,531	0	176,531	0	0	21,954	4,308	150,269	8,403	42,479	32,941	56,771	5,769	0	3,906	5,077	32,426	8,597	150	2
101	Florida Public Service Co	3	28,228	0	0	105,391	3,201	108,592	0	6,244	19,799	16,743	65,806	0	18,785	8,858	35,035	1,004	0	2,124	0	14,800	3,001	228	393
	Totals for section (g)	88	1,454,313	56	732,674	7,467,495	2,603,962	10,071,457	100,791	64,238	1,336,037	989,421	7,580,970	81,329	1,452,032	1,419,321	3,976,657	130,090	409,492	112,049	53,644	1,241,626	233,210	5,356	6,786
	East South Central States																								
102	Tennessee Valley Authority	9	221,920	17	772,185	4,874,126	−128,068	4,746,058	0	252,041	402,206	2,615,342	1,476,469	3,964	10,919	3,376	1,456,915	164	0	1,131	3,078	2,171	374	19	3
103	Agencies Distributing TVA Power (Consol. Rept.)	0	0	1	1,440	1,240	2,004,949	2,006,189	0	0	201,155	0	1,805,034	100,148	378,137	309,787	916,922	31,621	48,900	19,519	95,427	266,812	57,747	1,187	457
104	Alabama Power Co	11	164,699	6	414,500	2,480,728	263,259	2,743,987	1,017	5,649	373,013	1,082,936	1,281,372	34,315	142,183	116,828	980,344	7,702	0	0	31,854	97,658	20,117	568	186
105	Louisville Gas & Elec. Co. (Ky.) and Subs. (D)	2	129,500	1	80,320	537,632	34,380	572,012	0	6,168	50,734	132,374	382,736	0	79,341	y 62,331	z 170,626	8,596	34,833	k 27,009	0	91,050	y 11,479	z 3,418	609
106	Birmingham Electric Co	1	11,300	0	0	(m)	370,769	370,769	33,835	1,949	38,388	0	296,597	0	62,870	28,794	200,330	3,087	0	k 1,516	0	67,866	8,430	750	244
107	Memphis Generating Co	1	54,000	0	0	253,559	0	253,559	0	0	0	o 253,559	0	0	0	0	0	0	0	0	0	0	0	0	0
108	Mississippi Power & Light Co	18	14,608	0	0	1,260	249,632	250,892	0	1,063	38,003	22,479	189,347	3,979	37,900	41,234	z 103,666	2,568	0	0	1,757	45,503	10,759	z 1,275	113
109	Mississippi Power Co	9	17,386	0	0	23,787	175,027	198,814	0	920	31,496	4,366	162,032	0	28,458	39,286	91,391	2,897	0	0	0	30,865	7,940	68	60
	Totals for section	51	613,413	25	1,268,445	8,172,332	2,969,948	11,142,280	34,852	267,790	1,134,995	4,111,056	5,593,587	142,406	739,808	601,636	3,920,194	56,635	83,733	49,175	132,116	601,925	116,846	7,285	1,672
	West South Central States																								
110	Houston Lighting & Power Co	4	206,336	0	0	771,476	14,274	785,750	0	3,740	79,485	24,186	678,339	3,050	114,290	196,448	309,126	4,806	4,894	45,725	1,945	132,937	19,423	732	921
111	Louisiana Power & Light Co	10	86,648	0	0	679,789	104,757	784,546	0	2,967	47,977	438,344	295,258	w 4,439	23,436	18,434	241,618	7,331	0	0	w 4,106	37,505	7,430	465	694
112	Gulf States Utilities Co	T 10	T 191,768	0	0	769,467	2,058	771,525	k 72	7,909	57,800	15,864	689,880	(f)	f 75,702	63,824	536,914	2,497	0	10,943	(f)	f 77,197	14,275	539	104
113	Oklahoma Gas and Electric Co	14	T 167,946	0	0	672,731	20,936	693,667	0	k 6,087	103,813	12,620	571,147	22,832	92,366	101,762	308,158	8,488	11,932	25,609	10,472	123,246	24,959	6,426	1,897
114	Texas Power & Light Co	9	96,940	0	0	580,222	23,633	603,855	0	(v)	v 129,236	82,069	392,550	w 8,807	68,510	74,571	190,249	7,220	16,681	26,512	w 11,130	104,195	21,096	2,889	2,134
115	Arkansas Power & Light Co	15	40,770	3	65,968	147,473	377,282	524,755	0	6,582	83,969	73,019	361,185	7,447	44,709	56,965	228,985	l 18,289	4,790	0	10,869	59,421	17,250	806	1,610
116	New Orleans Public Service Inc	1	138,000	0	0	508,685	0	508,685	34,439	4,931	43,704	101,634	323,977	0	65,360	104,751	115,812	12,540	0	25,514	0	96,780	14,735	1,330	590
117	Texas Electric Service Co	9	96,876	0	0	439,331	58,522	497,853	0	0	101,509	20,438	375,906	2,977	62,628	y 90,003	z 183,094	6,835	5,070	25,299	2,825	78,798	y 13,361	z 1,290	862
118	Dallas Power & Light Co	2	113,750	0	0	355,866	0	355,866	0	3,684	38,156	0	314,026	354	75,073	135,779	44,294	7,054	26,484	24,988	246	81,107	9,232	993	432
119	Central Power and Light Co	29	69,003	5	15,000	301,190	35,350	336,540	0	24,019	63,146	20,638	228,737	8,228	47,454	69,000	92,316	2,559	0	9,180	5,898	55,564	19,104	1,070	397
120	Southwestern Gas and Electric Co	9	54,515	0	0	260,272	60,606	320,878	0	5,643	40,367	19,699	255,169	414	53,088	90,470	90,093	4,093	9,211	7,800	368	66,236	15,097	100	462
121	Public Service Co. of Oklahoma	11	99,241	0	0	277,114	35,453	312,567	0	2,887	38,982	30,024	240,674	1,894	52,406	30,430	146,362	3,017	706	5,859	1,340	62,948	11,260	1,986	369
122	West Texas Utilities Co	15	T 52,082	0	0	277,778	8,637	286,415	0	9,539	45,201	77,538	154,137	1,320	38,515	34,104	70,875	1,873	22	7,428	895	39,180	11,217	997	875
123	San Antonio Public Service Co	3	97,400	2	1,100	243,094	39,822	282,916	0	2,239	33,784	20,873	226,020	3,628	47,611	87,473	56,714	2,792	0	27,802	2,538	67,041	11,428	218	305
124	Lower Colorado River Authority	1	606	7	49,385	150,366	13,985	164,351	0	633	13,521	94,668	55,529	629	7,915	5,685	37,473	518	0	3,309	910	6,963	2,005	77	50
125	El Paso Electric Co	5	56,649	0	0	154,727	2,598	157,325	4,157	1,399	16,467	11,838	123,464	2,721	22,988	25,010	59,359	1,048	0	12,338	1,578	21,213	3,428	111	121
126	Panhandle Power & Light Co	4	53,096	0	0	148,543	38	148,581	0	343	9,093	3,934	135,211	328	1,984	3,817	128,949	76	0	57	236	2,829	1,157	43	14
127	Southwestern Public Service Co. (D)	8	36,321	2	488	29,329	73,553	102,882	0	3,889	12,450	10,806	75,737	2,347	14,879	22,107	27,205	1,774	0	7,425	2,601	18,627	4,419	1,676	39
	Totals for section	159	1,657,947	19	131,941	6,767,453	871,504	7,638,957	38,668	86,491	958,660	1,058,192	5,496,946	71,415	908,914	1,210,633	2,867,596	92,810	79,790	265,788	57,957	1,131,787	220,876	21,748	11,876
	Rocky Mountain States																								
128	Bureau of Reclamation, Boulder Dam	0	0	1	704,800	3,072,604	0	3,072,604	0	17,176	18,604	3,030,219	6,605	0	3,210	1,843	0	0	0	1,552	0	605	81	0	2
129	The Montana Power Co	0	0	14	T 349,750	1,712,088	1,663	1,713,751	0	21,603	v 211,257	74,651	1,406,240	4,336	66,982	60,467	1,126,996	8,825	101,653	36,981	2,920	75,050	11,034	1,198	1,279
130	Utah Power & Light Co	6	61,970	29	178,192	692,170	383,888	1,076,058	0	k 6,534	158,213	12,055	899,256	w 18,450	100,809	d 744,955	(d)	7,603	19,758	7,681	w 16,524	83,308	d 11,105	(d)	334
131	Idaho Power Co	2	612	13	105,610	717,997	27,394	745,391	0	5,043	89,354	397,828	253,166	69,563	69,956	50,891	59,351	3,405	0	0	21,787	37,103	9,810	93	54
132	Public Service Co. of Colorado	L 12	L 114,507	L 10	L 42,975	514,904	30,864	545,768	0	5,422	72,230	60,358	407,758	9,958	81,468	103,291	194,612	8,541	0	k 9,888	5,472	109,303	18,528	6,327	340
133	Salt River Valley Water Users' Assn	1	10,000	8	70,950	168,004	281,047	449,051	0	62,840	74,537	55,836	255,838	0	15,347	0	141,391	0	0	99,100	0	7,020	0	5	368
134	Central Arizona Light & Power Co	2	43,000	0	0	162,320	17,927	180,247	0	0	26,847	1,998	151,402	4,115	28,102	24,696	83,043	2,380	1,827	7,239	915	26,072	3,966	118	189
	Totals for section	23	230,089	75	1,452,277	7,040,087	742,783	7,782,870	0	118,618	651,042	3,632,945	3,380,265	106,422	365,874	986,143	1,605,393	30,754	123,238	162,441	47,618	338,461	54,524	7,741	2,566

h Beloit W. G. & E. Co.	6	50,270	30	43,996	356,106	20,279	376,385	387	6,362	67,400	85,721	216,515	20,280	68,102	67,251	52,847	7,179	0	856	18,415	83,666	17,717	111	245	120,154	57
	2	16,000	1	384	1,193	291,942	293,135	0	1,458	47,636	33,883	210,158	7,253	30,262	23,721	138,621	3,150	0	7,151	6,534	45,330	8,541	1,067	869	62,341	58
	1	31,000	0	0	79,905	156,172	236,077	12,435	694	16,614	28,799	177,535	2,131	21,479	20,078	126,450	668	4,065	2,664	2,369	19,633	2,931	882	233	26,048	59
g Commission	1	80,000	0	0	229,070	4,154	233,224	0	119,733	13,747	0	99,744	0	0	199	24,448	0	75,097	0	0	0	19	15	1	35	60
ago	0	0	1	X 35,000	74,907	153,768	228,675	0	925	4,491	0	223,259	0	0	*d* 798	(*d*)	*l* 122,725	0	*o* 99,736	0	0	*d* 9	(*d*)	5	14	61
blic Utilities	1	50,000	0	0	193,141	4,150	197,291	0	(*v*)	*v* 22,213	2,410	172,668	0	42,053	40,700	59,116	30,799	0	0	0	45,896	8,698	194	1	54,789	62
Co	3	62,800	0	0	168,752	0	168,752	0	1,322	19,363	197	147,870	*s* 100	30,509	38,400	74,123	3,442	1,296	0	0	36,466	4,783	77	11	41,337	63
& Elec. Lt. Commrs.	2	86,500	2	1,200	166,800	305	167,105	0	640	8,390	0	158,075	0	39,440	33,912	80,182	4,541	0	0	0	26,235	3,367	59	2	29,663	64
Gas Co	4	46,238	1	1,200	102,295	53,197	155,492	619	6,108	16,667	0	132,098	3,180	32,624	24,910	60,680	3,901	0	6,803	2,748	38,542	5,349	559	355	47,553	65
o	1	27,000	0	0	70,229	76,402	146,631	0	622	16,211	20,204	109,594	10,440	19,327	15,144	58,916	2,418	0	3,349	12,305	25,490	5,318	862	613	44,588	66
Co	3	16,490	9	15,938	113,414	10,892	124,306	0	664	16,797	2,390	104,455	1,888	15,676	12,341	70,537	1,868	0	2,145	*a* 2,266	*a* 16,544	*a* 4,260	*a* 44	*a* 267	*a* 23,381	67
	1	50,000	0	0	78,120	24,288	102,408	0	1,469	9,239	33	91,667	9,413	26,701	33,306	11,505	2,066	0	8,676	4,270	18,223	3,240	98	15	25,846	68
	133	7,919,148	164	586,472	31,628,898	2,190,650	33,819,548	50,476	322,951	3,885,139	3,154,271	26,406,711	341,898	4,850,701	3,814,017	14,777,996	653,913	1,502,244	465,942	279,618	4,934,403	719,332	31,074	20,071	5,984,498	
ntral States																										
i and Subs. (*D*)	5	474,420	2	237,000	2,749,478	38	2,749,516	1,352	14,120	312,829	451,925	1,969,290	19,419	318,686	248,397	1,203,557	33,588	129,576	16,067	17,163	299,018	39,451	407	132	356,171	69
inn.) & Subs. (*D*)	21	344,826	*u* 27	*u* 147,495	1,494,193	77,818	1,572,011	0	13,074	223,446	87,549	1,247,942	13,563	406,530	260,638	473,716	31,380	4,079	58,036	9,528	339,963	48,138	20,683	917	419,229	70
Co	5	273,211	0	0	805,884	2,320	808,204	0	8,788	72,663	50,743	676,010	8,280	131,170	162,731	238,210	13,394	83,692	38,533	6,756	127,546	24,748	214	1,197	160,461	71
	5	30,270	11	94,911	493,126	566	493,692	0	2,021	69,754	63,873	358,044	3,099	40,670	43,141	253,462	3,212	5,761	8,699	(*P*)	(*P*)	(*P*)	(*P*)	(*P*)52,134	52,134	72
	T 3	*T* 111,750	0	0	437,446	17,417	454,863	0	2,417	39,458	39,900	373,088	9,265	74,711	(*d*)	*d* 221,037	9,046	26,312	32,717	*a* 5,573	*a* 73,350	(*d,a*)	*d,a* 11,031	*a* 600	*a* 90,554	73
	3	89,000	0	0	335,763	46	335,809	0	2,216	45,463	18,368	269,762	6,061	50,932	50,453	151,272	2,906	633	7,505	5,456	59,554	7,913	865	786	74,574	74
Co	1	71,500	4	27,320	291,884	−2,941	288,943	0	1,286	57,720	74,080	155,857	3,464	14,391	15,656	118,281	1,935	30	2,100	*a* 3,608	*a* 21,893	*a* 5,003	*a* 520	*a* 71	*a* 31,095	75
a P. S. Co. System	21	88,517	4	2,051	256,255	6,985	263,240	0	5,264	36,254	18,782	202,940	6,182	52,124	*d* 120,745	(*d*)	6,940	7,489	9,460	7,485	68,406	*d* 17,083	(*d*)	304	93,278	76
. (*D*)	2	107,000	1	400	259,617	0	259,617	0	1,200	37,980	20,615	199,822	4,302	50,892	35,816	92,379	6,277	0	10,156	3,568	54,166	8,832	174	471	67,211	77
nd Subs. (*D*)	24	69,459	13	7,135	186,836	38,290	225,126	0	1,712	37,931	36,113	149,370	5,585	49,310	54,504	27,217	5,945	532	6,277	4,466	61,575	17,873	59	416	84,389	78
Co	8	57,503	2	1,400	219,729	1,158	220,887	4,010	2,274	23,888	38,740	151,975	5,614	36,331	19,930	87,052	3,048	0	0	5,104	42,550	7,933	2,021	92	57,700	79
f Public Utilities	1	69,000	0	0	169,913	0	169,913	0	*o* 15,063	14,420	0	140,430	0	30,025	21,635	84,739	3,280	751	0	0	29,763	4,041	66	2	33,872	80
wer Co	15	45,265	5	2,235	126,049	38,867	164,916	0	2,741	22,289	16,014	123,872	3,637	38,369	40,601	32,791	2,894	984	4,596	3,373	48,666	11,589	61	310	63,999	81
m	3	68,500	0	0	162,882	82	162,964	0	49	22,623	14	140,278	0	31,835	16,132	92,311	0	0	0	0	33,840	4,013	992	0	38,845	82
	n 1	*n* 3,000	*u* 6	*u* 127,838	126,608	26,764	153,372	0	2,481	25,315	125,576	0	0	0	0	0	0	0	0	0	0	0	0	0	0	83
	5	25,107	0	0	73,908	49,725	123,633	371	508	22,149	8,981	91,624	2,895	30,081	25,155	30,341	2,726	0	426	3,248	42,343	9,998	386	177	56,152	84
	7	37,713	5	4,930	112,779	39	112,818	0	404	25,505	18,911	67,998	1,081	28,677	24,660	9,164	2,288	0	2,128	1,317	29,703	10,796	28	516	42,360	85
	130	1,966,041	80	652,715	8,302,350	257,174	8,559,524	5,733	75,618	1,089,687	1,070,184	6,318,302	92,447	1,384,734	1,140,194	3,115,529	128,859	259,839	196,700	76,645	1,332,336	217,411	37,507	58,125	1,722,024	
tic States																										
					O 2,686,739	368,023	3,054,762																			86
	19	94,439	22	287,500	1,362,696	860,143	2,222,839	54,574	11,841	377,466	165,137	1,613,821	0	283,255	279,524	1,030,975	19,002	1,065	0	0	191,825	40,553	524	410	233,312	87
ower Co., Baltimore	4	273,450	0	0	877,528	1,041,127	1,918,655	0	*v* 3,131	*x* 157,110	*x* 5,847	1,752,567	(*w*)	221,218	264,505	928,815	15,830	301,776	*s* 20,423	(*w*)	256,942	41,420	227	27	298,616	88
	2	43,000	10	206,050	840,835	345,728	1,186,563	0	2,513	207,182	115,940	860,928	28,531	102,998	75,542	618,698	8,294	0	26,865	24,867	75,571	15,776	1,103	1,910	119,227	89
	2	305,000	0	0	1,149,713	−59,010	1,090,703	0	6,661	121,485	18,175	944,382	(*f*)	*f* 218,689	240,483	365,525	27,047	92,638	0	(*f*)	*f* 176,626	27,704	391	41	204,762	90
	2	181,000	8	32,635	977,739	−98,693	879,046	34,163	*k* 8,451	106,829	31,236	698,367	(*f*)	*f* 165,497	172,026	327,899	4,253	0	28,692	(*f*)	*f* 142,246	25,909	405	1,133	169,693	91
	35	163,593	0	0	481,378	2,289	483,667	0	*o* 5,653	84,789	185	393,040	27,607	149,367	133,064	46,450	*l* 33,987	*k* 2,565	0	*a* 11,498	*a* 107,369	*a* 23,056	*a* 862	*a* 1,607	*a* 144,392	92
	8	83,402	9	14,066	403,320	12,624	415,944	4,027	5,970	65,455	15,836	324,656	11,568	87,533	60,592	141,787	5,124	0	18,052	8,208	90,441	14,894	619	202	114,364	93
s Co	1	*n* 72,500	2	24,630	386,573	29,289	415,862	0	5,453	39,748	202,219	168,442	*w* 2,225	18,327	24,946	117,483	1,463	0	3,998	*w* 1,848	18,146	5,057	242	115	25,408	94
	5	44,631	3	14,193	244,980	19,880	264,860	0	2,499	59,814	119,025	83,522	0	37,869	25,715	14,807	792	0	4,339	0	34,945	6,990	226	554	42,715	95
	0	0	1	130,000	132,784	126,884	259,668	0	9	4,644	255,015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96
	1	*T* 22,500	0	0	59	251,955	252,014	0	1,505	16,370	13,412	220,727	594	36,519	*y* 48,672	*z* 120,115	2,879	11,448	500	430	35,963	*y* 6,903	*z* 196	25	43,517	97
	3	19,570	1	23,600	136,806	63,592	200,398	0	1,118	27,139	26,336	145,805	0	38,604	27,493	77,531	2,177	0	0	0	25,995	6,865	109	45	33,014	98
	2	42,500	0	0	191,162	4,953	196,115	8,027	3,190	26,253	7	158,638	2,401	30,892	24,960	94,766	2,469	0	3,150	1,716	38,331	6,485	74	322	46,928	99
Plant	1	81,500	0	0	176,531	0	176,531	0	0	21,954	4,308	150,269	8,403	42,479	32,941	56,771	5,769	0	3,906	5,077	32,426	8,597	150	2	46,252	100
	3	28,228	0	0	105,391	3,201	108,592	0	6,244	19,799	16,743	65,806	0	18,785	8,858	35,035	1,004	0	2,124	0	14,800	3,001	228	393	18,422	101
	88	1,454,313	56	732,674	7,467,495	2,603,962	10,071,457	100,791	64,238	1,336,037	989,421	7,580,970	81,329	1,452,032	1,419,321	3,976,657	130,090	409,492	112,049	53,644	1,241,626	233,210	5,356	6,786	1,540,622	
ntral States																										
	9	221,920	17	772,185	4,874,126	−128,068	4,746,058	0	252,041	402,206	2,615,342	1,476,469	3,964	10,919	3,376	1,456,915	164	0	1,131	3,078	2,171	374	19	3	5,645	102
/A Power (Consol. Rept.)	0	0	1	1,440	1,240	2,004,949	2,006,189	0	0	201,155	0	1,805,034	100,148	378,137	309,787	916,922	31,621	48,900	19,519	95,427	266,812	57,747	1,187	457	421,630	103
Ky.) and Subs. (*D*)	11	164,699	6	414,500	2,480,728	263,259	2,743,987	1,017	5,649	373,013	1,082,936	1,281,372	34,315	142,183	116,828	980,344	7,702	0	0	31,854	97,658	20,117	568	186	150,383	104
	2	129,500	1	80,320	537,632	34,380	572,012	0	6,168	50,734	132,374	382,736	0	79,341	*y* 62,331	*z* 170,626	8,596	34,833	*k* 27,009	0	91,050	*y* 11,479	*z* 3,418	609	106,556	105
	1	11,300	0	0	(*m*)	370,769	370,769	33,835	1,949	38,388	0	296,597	0	62,870	28,794	200,330	3,087	0	*k* 1,516	0	67,866	8,430	750	244	77,290	106
	1	54,000	0	0	253,559	0	253,559	0	0	0	*o* 253,559	0	0	0	0	0	0	0	0	0	0	0	0	0	0	107
o	18	14,608	0	0	1,260	249,632	250,892	0	1,063	38,003	22,479	189,347	3,979	37,900	41,234	*z* 103,666	2,568	0	0	1,757	45,503	10,759	*z* 1,275	113	59,407	108
	9	17,386	0	0	23,787	175,027	198,814	0	920	31,496	4,366	162,032	0	28,458	39,286	91,391	2,897	0	0	0	30,865	7,940	68	60	38,933	109
	51	613,413	25	1,268,445	8,172,332	2,969,948	11,142,280	34,852	267,790	1,134,995	4,111,056	5,593,587	142,406	739,808	601,636	3,920,194	56,635	83,733	49,175	132,116	601,925	116,846	7,285	1,672	859,844	
ntral States																										
o	4	206,336	0	0	771,476	14,274	785,750	0	3,740	79,485	24,186	678,339	3,050	114,290	196,448	309,126	4,806	4,894	45,725	1,945	132,937	19,423	732	921	155,958	110
	10	86,648	0	0	679,789	104,757	784,546	0	2,967	47,977	438,344	295,258	*w* 4,439	23,436	18,434	241,618	7,331	0	0	*w* 4,106	37,505	7,430	465	694	50,200	111
	T 10	*T* 191,768	0	0	769,467	2,058	771,525	*k* 72	7,909	57,800	15,864	689,880	(*f*)	*f* 75,702	63,824	536,914	2,497	0	10,943	(*f*)	*f* 77,197	14,275	539	104	92,115	112
Co	14	*T* 167,946	0	0	672,731	20,936	693,667	0	*k* 6,087	103,813	12,620	571,147	22,832	92,366	101,762	308,158	8,488	11,932	25,609	10,472	123,246	24,959	6,426	1,897	167,000	113
	9	96,940	0	0	580,222	23,633	603,855	0	(*v*)	*v* 129,236	82,069	392,550	*w* 8,807	68,510	74,571	190,249	7,220	16,681	26,512	*w* 11,130	104,195	21,096	2,889	2,134	141,444	114
	15	40,770	3	65,968	147,473	377,282	524,755	0	6,582	83,969	73,019	361,185	7,447	44,709	56,965	228,985	*l* 18,289	4,790	0	10,869	59,421	17,250	806	1,610	89,956	115
nc	1	138,000	0	0	508,685	0	508,685	34,439	4,931	43,704	101,634	323,977	0	65,360	104,751	115,812	12,540	0	25,514	0	96,780	14,735	1,330	590	113,435	116
	9	96,876	0	0	439,331	58,522	497,853	0	0	101,509	20,438	375,906	2,977	62,628	*y* 90,003	*z* 183,094	6,835	5,070	25,299	2,825	78,798	*y* 13,361	*z* 1,290	862	97,136	117
	2	113,750	0	0	355,866	0	355,866	0	3,684	38,156	0	314,026	354	75,073	135,779	44,294	7,054	26,484	24,988	246	81,107	9,232	993	432	92,010	118
Co	29	69,003	5	15,000	301,190	35,350	336,540	0	24,019	63,146	20,638	228,737	8,228	47,454	69,000	92,316	2,559	0	9,180	5,898	55,564	19,104	1,070	397	82,033	119
ic Co	9	54,515	0	0	260,272	60,606	320,878	0	5,643	40,367	19,699	255,169	414	53,088	90,470	90,093	4,093	9,211	7,800	368	66,236	15,097	100	462	82,263	120
ma	11	99,241	0	0	277,114	35,453	312,567	0	2,887	38,982	30,024	240,674	1,894	52,406	30,430	146,362	3,017	706	5,859	1,340	62,948	11,260	1,986	369	77,903	121
	15	*T* 52,082	0	0	277,778	8,637	286,415	0	9,539	45,201	77,538	154,137	1,320	38,515	34,104	70,875	1,873	22	7,428	895	39,180	11,217	997	875	53,164	122
o	3	97,400	2	1,100	243,094	39,822	282,916	0	2,239	33,784	20,873	226,020	3,628	47,611	87,473	56,714	2,792	0	27,802	2,538	67,041	11,428	218	305	81,530	123
rity	1	606	7	49,385	150,366	13,985	164,351	0	633	13,521	94,668	55,529	629	7,915	5,685	37,473	518	0	3,309	910	6,963	2,005	77	50	10,005	124
	5	56,649	0	0	154,727	2,598	157,325	4,157	1,399	16,467	11,838	123,464	2,721	22,988	25,010	59,359	1,048	0	12,338	1,578	21,213	3,428	111	121	26,451	125
	4	53,096	0	0	148,543	38	148,581	0	343	9,093	3,934	135,211	328	1,984	3,817	128,949	76	0	57	236	2,829	1,157	43	14	4,279	126
Co. (*D*)	8	36,321	2	488	29,329	73,553	102,882	0	3,889	12,450	10,806	75,737	2,347	14,879	22,107	27,205	1,774	0	7,425	2,601	18,627	4,419	1,676	39	27,362	127
	159	1,657,947	19	131,941	6,767,453	871,504	7,638,957	38,668	86,491	958,660	1,058,192	5,496,946	71,415	908,914	1,210,633	2,867,596	92,810	79,790	265,788	57,957	1,131,787	220,876	21,748	11,876	1,444,244	
tain States																										
der Dam	0	0	1	704,800	3,072,604	0	3,072,604	0	17,176	18,604	3,030,219	6,605	0	3,210	1,843	0	0	0	1,552	0	605	81	0	2	688	128
	0	0	14	*T* 349,750	1,712,088	1,663	1,713,751	0	21,603	*v* 211,257	74,651	1,406,240	4,336	66,982	60,467	1,126,996	8,825	101,653	36,981	2,920	75,050	11,034	1,198	1,279	91,481	129
	6	61,970	29	178,192	692,170	383,888	1,076,058	0	*k* 6,534	158,213	12,055	899,256	*w* 18,450	100,809	*d* 744,955	(*d*)	7,603	19,758	7,681	*w* 16,524	83,308	*d* 11,105	(*d*)	334	111,271	130
	2	612	13	105,610	717,997	27,394	745,391	0	5,043	89,354	397,828	253,166	69,563	69,956	50,891	59,351	3,405	0	0	21,787	37,103	9,810	93	54	68,847	131
lo	*L* 12	*L* 114,507	*L* 10	*L* 42,975	514,904	30,864	545,768	0	5,422	72,230	60,358	407,758	9,958	81,468	103,291	194,612	8,541	0	*k* 9,888	5,472	109,303	18,528	6,327	340	139,970	132
s' A	1	10,000	8	70,950	168,004	281,047	449,051	0	62,840	74,537	55,836	255,838	0	15,347	0	141,391	0	0	99,100	0	7,020	0	5	368	7,393	133
vel																										

113	Oklahoma Gas and Electric Co.	14	2 167,750	0	0	872,231	20,238	892,469	0	2 0,002	167,752	12,020	2 21,510	392,550	w 22,802	52,508	167,752	390,749	8,500	11,532	27,002	10,412	123,248	27,533	6,126	1,197
114	Texas Power & Light Co.	9	96,940	0	0	580,222	23,633	603,855	0	(v)	v 129,236	82,069	392,550	w 8,807	68,510	74,571	190,249	7,220	16,681	26,512	w 11,130	104,195	21,096	2,889	2,134
115	Arkansas Power & Light Co.	15	40,770	3	65,968	147,473	377,282	524,755	0	6,582	83,969	73,019	361,185	7,447	44,709	56,965	228,985	l 18,289	4,790	0	10,869	59,421	17,250	806	1,610
116	New Orleans Public Service Inc.	1	138,000	0	0	508,685	0	508,685	34,439	4,931	43,704	101,634	323,977	0	65,360	104,751	115,812	12,540	0	25,514	0	96,780	14,735	1,330	590
117	Texas Electric Service Co.	9	96,876	0	0	439,331	58,522	497,853	0	0	101,509	20,438	375,906	2,977	62,628	y 90,003	z 183,094	6,835	5,070	25,299	2,825	78,798	y 13,361	z 1,290	862
118	Dallas Power & Light Co.	2	113,750	0	0	355,866	0	355,866	0	3,684	38,156	0	314,026	354	75,073	135,779	44,294	7,054	26,484	24,988	246	81,107	9,232	993	432
119	Central Power and Light Co.	29	69,003	5	15,000	301,190	35,350	336,540	0	24,019	63,146	20,638	228,737	8,228	47,454	69,000	92,316	2,559	0	9,180	5,898	55,564	19,104	1,070	397
120	Southwestern Gas and Electric Co.	9	54,515	0	0	260,272	60,606	320,878	0	5,643	40,367	19,699	255,169	414	53,088	90,470	90,093	4,093	9,211	7,800	368	66,236	15,097	100	462
121	Public Service Co. of Oklahoma	11	99,241	0	0	277,114	35,453	312,567	0	2,887	38,982	30,024	240,674	1,894	52,406	30,430	146,362	3,017	706	5,859	1,340	62,948	11,260	1,986	369
122	West Texas Utilities Co.	15	T 52,082	0	0	277,778	8,637	286,415	0	9,539	45,201	77,538	154,137	1,320	38,515	34,104	70,875	1,873	22	7,428	895	39,180	11,217	997	875
123	San Antonio Public Service Co.	3	97,400	2	1,100	243,094	39,822	282,916	0	2,239	33,784	20,873	226,020	3,628	47,611	87,473	56,714	2,792	0	27,802	2,538	67,041	11,428	218	305
124	Lower Colorado River Authority	1	606	7	49,385	150,366	13,985	164,351	0	633	13,521	94,668	55,529	629	7,915	5,685	37,473	518	0	3,309	910	6,963	2,005	77	50
125	El Paso Electric Co.	5	56,649	0	0	154,727	2,598	157,325	4,157	1,399	16,467	11,838	123,464	2,721	22,988	25,010	59,359	1,048	0	12,338	1,578	21,213	3,428	111	121
126	Panhandle Power & Light Co.	4	53,096	0	0	148,543	38	148,581	0	343	9,093	3,934	135,211	328	1,984	3,817	128,949	76	0	57	236	2,829	1,157	43	14
127	Southwestern Public Service Co. (D)	8	36,321	2	488	29,329	73,553	102,882	0	3,889	12,450	10,806	75,737	2,347	14,879	22,107	27,205	1,774	0	7,425	2,601	18,627	4,419	1,676	39
	Totals for section	159	1,657,947	19	131,941	6,767,453	871,504	7,638,957	38,668	86,491	958,660	1,058,192	5,496,946	71,415	908,914	1,210,633	2,867,596	92,810	79,790	265,788	57,957	1,131,787	220,876	21,748	11,876
	Rocky Mountain States																								
128	Bureau of Reclamation, Boulder Dam	0	0	1	704,800	3,072,604	0	3,072,604	0	17,176	18,604	3,030,219	6,605	0	3,210	1,843	0	0	0	1,552	0	605	81	0	2
129	The Montana Power Co.	0	0	14	T 349,750	1,712,088	1,663	1,713,751	0	21,603	v 211,257	74,651	1,406,240	4,336	66,982	60,467	1,126,996	8,825	101,653	36,981	2,920	75,050	11,034	1,198	1,279
130	Utah Power & Light Co.	6	61,970	29	178,192	692,170	383,888	1,076,058	0	k 6,534	158,213	12,055	899,256	w 18,450	100,809	d 744,955	(d)	7,603	19,758	7,681	w 16,524	83,308	d 11,105	(d)	334
131	Idaho Power Co.	2	612	13	105,610	717,997	27,394	745,391	0	5,043	89,354	397,828	253,166	69,563	69,956	50,891	59,351	3,405	0	0	21,787	37,103	9,810	93	54
132	Public Service Co. of Colorado	L 12	L 114,507	L 10	L 42,975	514,904	30,864	545,768	0	5,422	72,230	60,358	407,758	9,958	81,468	103,291	194,612	8,541	0	k 9,888	5,472	109,303	18,528	6,327	340
133	Salt River Valley Water Users' Assn.	1	10,000	8	70,950	168,004	281,047	449,051	0	62,840	74,537	55,836	255,838	0	15,347	0	141,391	0	0	99,100	0	7,020	0	5	368
134	Central Arizona Light & Power Co.	2	43,000	0	0	162,320	17,927	180,247	0	0	26,847	1,998	151,402	4,115	28,102	24,696	83,043	2,380	1,827	7,239	915	26,072	3,966	118	189
	Totals for section	23	230,089	75	1,452,277	7,040,087	742,783	7,782,870	0	118,618	651,042	3,632,945	3,380,265	106,422	365,874	986,143	1,605,393	30,754	123,238	162,441	47,618	338,461	54,524	7,741	2,566
	Pacific States																								
135	Pacific Gas and Electric Co.	10	479,625	49	882,441	4,689,287	1,368,987	6,058,274	2,708	68,410	1,315,204	256,659	4,415,293	927,814	508,722	638,782	2,051,188	72,994	205,856	9,937	211,931	571,857	141,465	4,306	583
136	Southern California Edison Co., Ltd.	L 4	L 399,000	L 24	L 576,020	3,590,755	63,641	3,654,396	0	0	723,215	397,888	2,533,293	421,101	357,666	245,663	1,127,263	43,309	228,723	109,568	43,018	433,195	61,816	24,537	4,900
137	City of Los Angeles, Dept. of Water & Power	3	187,500	6	440,605	1,884,172	9,895	1,894,067	0	11,111	286,801	54,196	1,541,959	0	390,414	802,893	269,291	63,950	0	15,411	0	a409,098	a 91,927	a 2,260	a 1,024
138	Puget Sound Power & Light Co.	3	94,500	12	193,190	1,202,704	42,922	1,245,626	0	13,851	272,240	33,619	925,916	11,808	254,224	245,250	352,004	5,582	39,695	17,353	1	179,759	23,997	615	271
139	The Washington Water Power Co.	0	0	12	203,534	1,112,013	104,258	1,216,271	0	41,064	169,060	177,299	828,848	14,222	138,349	119,938	506,051	6,673	39,534	4,081	11,828	61,421	10,191	568	93
140	Portland General Electric Co.	3	90,000	7	93,465	546,585	296,372	842,957	0	2,314	133,925	7,024	699,694	52,752	133,780	126,684	298,875	13,449	48,543	25,611	40,973	83,986	14,232	301	1,151
141	The California Oregon Power Co.	1	15,000	12	100,080	624,475	18,594	643,069	0	4,191	91,114	372,859	174,905	12,328	62,462	32,127	65,810	1,595	0	583	3,438	27,204	6,778	102	85
142	City of Seattle, Dept. of Lighting	1	30,000	4	219,256	592,683	17	592,700	0	15,548	104,273	113,155	359,724	0	137,060	70,283	84,737	18,403	25,233	24,008	0	80,150	8,786	3,050	1,196
143	Hetch Hetchy Pwr. & Util. Engr. Bureau	0	0	2	83,000	528,727	0	528,727	0	1,283	33,838	493,606	0	0	0	0	0	0	0	0	0	0	0	0	0
144	Northwestern Electric Co.	2	42,500	1	9,600	253,860	248,271	502,131	0	1,128	62,845	82,136	356,022	0	61,831	y 60,067	z 227,323	1,463	0	5,338	0	43,439	y 5,905	z 586	649
145	City of Tacoma, Dept. of Public Utilities	2	34,000	3	114,000	432,449	68,959	501,408	0	1,484	76,615	11,914	411,395	0	73,589	41,950	272,139	7,264	483	15,970	0	33,685	3,929	982	270
146	The Nevada-California Electric Corp.	2	8,135	8	48,875	240,365	179,039	419,404	H 165	7,759	108,329	69,485	233,666	47,491	34,247	d 145,298	(d)	912	0	k 5,718	1,455	28,236	d 6,156	(d)	61
147	Bonneville Power Administration	0	0	1	140,400	374,176	440	374,616	0	0	20,057	259,393	95,166	0	0	0	95,166	0	0	0	0	0	0	2	0
148	San Diego Gas & Electric Co.	1	99,000	0	0	290,946	35,014	325,960	0	3,860	40,958	2,092	279,050	44,620	56,478	61,835	86,930	6,654	15,054	7,479	17,054	69,722	14,570	148	131
149	Pacific Power & Light Co.	1	10,000	10	21,967	156,758	165,125	321,883	0	4,799	65,643	20,929	230,512	15,920	82,439	124,168	0	3,383	1,708	2,894	17,268	54,076	14,784	0	207
150	Inland Power & Light Co.	0	0	2	45,800	227,045	8,060	235,105	0	0	406	234,699	0	0	0	0	0	0	0	0	0	0	0	0	0
151	Mountain States Power Co.	L 16	15,111	7	6,686	59,791	154,395	214,186	0	k 3,031	32,771	7,674	170,710	746	69,011	25,961	72,089	2,903	0	0	284	50,668	8,990	2,835	70
152	Turlock-Modesto Irrigation Districts	1	1,000	2	31,000	177,453	1,510	178,963	0	15,014	19,650	68,589	75,710	(P)	(P)	(P)	(P)	(P)	(P)	P 75,710	(P)	(P)	(P)	(P)	P 19,780
153	PUD No. 1, Cowlitz Co., Wash.	1	27,000	0	0	169,521	−4,164	165,357	0	1,134	7,576	366	156,281	(f)	f 5,630	3,398	146,383	296	0	k 574	(f)	f 4,682	461	120	33
154	Merced Irrigation District	0	0	1	X 31,250	128,530	0	128,530	0	0	0	x 128,530	0	0	0	0	0	0	0	0	0	0	0	0	0
155	East Bay Municipal Utility District	0	0	1	15,000	104,003	0	104,003	0	0	0	104,003	0	0	0	0	0	0	0	0	0	0	0	0	0
	Totals for section	51	1,532,371	164	3,256,169	17,386,298	2,761,335	20,147,633	2,873	195,981	3,564,520	2,896,115	13,488,144	1,548,802	2,365,902	2,744,297	5,655,249	248,830	604,829	320,235	347,250	2,131,178	413,987	40,412	30,504
	Canada																								
156	Hydro-Electric Power Commission of Ontario (g)	1	25,000	45	1,352,690	6,655,728	3,149,264	9,804,992																	
157	Shawinigan Water & Power Co. & Subs. (D)	0	0	20	X 876,000	4,540,015	1,359,590	5,899,605	0	24,199	397,139	801,994	4,676,273	5,487	73,722	167,892	3,211,225	4,698	16,698	Q1,196,551	17,607	95,280	23,997	45	337
158	Montreal Light, Heat & Power Cons. & Subs. (D)	1	20,000	5	586,020	3,004,133	988,917	3,993,050	H 48,505	0	195,548	1,363,664	2,385,333	2,062	150,027	192,822	1,890,448	16,456	133,518	0	2,427	226,392	36,450	5,963	24
159	Gatineau Power Co.	1	6,750	17	534,608	3,075,088	3,004	3,078,092	0	0	42,277	1,679,272	1,356,543	w 1,038	12,607	y 9,659	z1,324,560	1,391	3,586	l 3,702	w 2,944	19,132	y 4,187	z 274	130
160	Saguenay Power Co., Ltd.	0	0	1	420,000	2,445,446	199,734	2,645,180	0	0	31,750	776,327	1,837,103	0	0	0	1,837,103	0	0	0	0	0	0	4	0
161	Aluminum Power Co., Ltd.	0	0	1	200,000	1,631,294	0	1,631,294	0	0	45,045	99,586	1,486,663	0	186	6	0	0	0	1,486,471	0	17	1	0	1
162	Winnipeg Electric Co.	1	X 12,000	3	X 251,100	776,465	7,019	783,484	0	0	84,013	39,329	660,142	0	108,006	47,131	273,112	1,742	32,709	197,442	0	25,030	5,172	1,590	28
163	Canada Northern Power Corp., Ltd.	0	0	9	94,375	477,522	265,308	742,830	0	8,784	49,359	0	684,687	0	33,319	24,673	625,075	1,620	0	0	0	21,487	4,336	59	18
164	Abitibi Power & Paper Co., Ltd. and Subs. (D) (g)	3	8,150	....	98,000	735,629	0	735,629																	
165	City of Winnipeg Hydro-Electric System	T 1	T 11,000	2	111,000	584,568	19	584,587	0	(t)	84,292	7,665	492,630	0	205,103	29,537	U242,316	15,674	0	0	0	41,755	2,377	3,687	6
166	British Columbia Elec. Railway Co., Ltd. (M)	1	X 17,500	5	X 211,325	537,674	0	537,674	82,247	9,708	85,773	9,079	350,867	(f)	f 97,251	68,376	173,036	12,204	0	0	(f)	f 96,925	15,927	2,804	19
167	Great Lakes Power Co., Ltd.	0	0	4	54,200	331,568	0	331,568	901	0	17,620	22,997	290,050	61	344	211	289,392	42	0	0	123	450	149	16	3
168	Southern Canada Power Co., Ltd.	0	0	5	43,865	177,018	63,754	240,772	0	l 1,288	36,704	49,596	153,184	1,055	19,733	11,226	102,626	3,582	0	14,962	1,673	23,286	4,545	544	121
169	Ottawa Light Heat & Power Co., Ltd.	1	4,000	2	12,200	90,325	133,821	224,146	0	(t)	.....	453	223,693	0	85,129	d 98,717	(d)	620	12,461	26,766	0	24,388	d 4,513	(d)	250
170	The Nova Scotia Power Commission	4	Z 374	14	Z 76,350	216,305	775	217,080	0	0	10,629	42,158	164,293	(f)	f 1,768	(f)	162,430	95	0	0	(f)	f 4,685	(f)	11	5
171	Calgary Power Co., Ltd.	5	X 13,077	3	X 53,000	157,849	3,325	161,174	0	973	23,878	99,872	36,451	447	5,232	10,359	18,931	1,482	0	0	353	10,133	5,550	35	105
172	East Kootenay Power Co., Ltd.	1	10,000	2	17,000	104,231	4,124	108,355	0	1,591	12,131	125	94,508	0	33	0	0	0	0	94,475	0	69	0	0	14
	Totals for Canada	16	94,701	93	3,541,043	18,149,501	3,029,390	21,178,891	131,653	46,543	1,116,158	4,992,117	14,892,420	10,150	792,460	660,609	10,150,254	59,606	198,972	3,020,369	25,127	589,029	107,204	15,032	1,061
	Mexico																								
173	The Mexican Lt. & Pwr. Co., Ltd. and Subs. (D)	2	32,240	15	211,873	1,119,657	28,796	1,148,453	0	21,389	371,942	0	755,122	1,515	101,897	49,047	4,353	13,934	80,855	503,521	127	217,570	56,648	49	9,032
	Railways and Railroads																								
174	Board of Transportation N.Y.C. Transit System	3	610,000	0	0	1,815,098	484,929	2,300,027																	
175	The Pennsylvania Railroad	0	0	0	0	0	G 1,204,407	G 1,204,407																	
176	Chicago Surface Lines	0	0	0	0	0	591,545	591,545																	
177	Philadelphia Transportation Co.	0	0	0	0	0	325,533	325,533																	
178	New York Central Railroad Co.	0	0	0	0	0	253,862	253,862																	
179	Boston Elevated Railway Co.	2	180,000	0	0	226,206	4,205	230,411																	
180	New York, New Haven & Hartford R. R. Co.	1	43,000	0	0	104,732	74,795	179,527																	
181	Norfolk & Western Railway Co.	3	41,885	0	0	97,014	43,183	140,197																	
182	St. Louis Public Service Co.	0	0	0	0	0	129,576	129,576																	
183	The Virginian Railway Co.	1	40,000	0	0	120,869	0	120,869																	
184	Pacific Electric Railway Co.	0	0	0	0	0	117,352	117,352																	
185	Twin City Rapid Transit Co.	1	74,000	L 2	L 16,000	80,923	B 35,593	116,516																	
186	Chicago, Milwaukee, St. Paul & Pacific R. R. Co.	0	0	0	0	0	115,091	115,091																	
	Totals for railways and railroads	11	988,885	2	16,000	2,444,842	3,380,071	5,824,913																	

SUMMARY OF GENERATOR RATING AND OUTPUT OF LARGE UTILITY SYSTEMS

Region	No. Cos. or System	Number of Generating Plants and Generator Rating — All Plants: Number	All Plants: Rating, Kw.	Fuel Plants: Number	Fuel Plants: Rating, Kw.	Hydro Plants: Number	Hydro Plants: Rating, Kw.	Energy Generated (Net) Thous. Kw.-Hr.	Rec'd by Purch. or Interchange Thous. Kw.-Hr.	Output Gen. and Purch. Thous. Kw.-Hr.
United States (g)	**155**	**1,717**	**35,584,122**	**810**	**24,858,949**	**907**	**10,725,173**	**130,933,103**	**17,253,166**	**148,186,269**
New England	18	203	2,553,973	47	1,743,337	156	810,636	8,152,190	1,870,538	10,022,728
Middle Atlantic	22	296	9,576,134	128	7,742,290	168	1,833,844	36,016,000	2,985,272	39,001,272
East North Central	28	297	8,505,620	133	7,919,148	164	586,472	31,628,898	2,190,650	33,819,548
West North Central	17	210	2,618,756	130	1,966,041	80	652,715	8,302,350	257,174	8,559,524
South Atlantic (g)	16	144	2,186,987	88	1,454,313	56	732,674	7,467,495	2,603,962	10,071,457
East South Central	8	76	1,881,858	51	613,413	25	1,268,445	8,172,332	2,969,948	11,142,280
West South Central	18	178	1,789,888	159	1,657,947	19	131,941	6,767,453	871,504	7,638,957
Mountain	7	98	1,682,366	23	230,089	75	1,452,277	7,040,087	742,783	7,782,870
Pacific	21	215	4,788,540	51	1,532,371	164	3,256,169	17,386,298	2,761,335	20,147,633
Canada (g)	**17**	**109**	**3,635,744**	**16**	**94,701**	**93**	**3,541,043**	**18,149,501**	**3,029,390**	**21,178,891**
Mexico	**1**	**17**	**244,113**	**2**	**32,240**	**15**	**211,873**	**1,119,657**	**28,796**	**1,148,453**
Railways and Railroads	**13**	**13**	**1,004,885**	**11**	**988,885**	**2**	**16,000**	**2,444,842**	**3,380,071**	**5,824,913**

	10	86,648	0	0	679,789	104,757	784,546	0	2,967	47,977	438,344	295,258	w 4,439	25,436	18,434	241,618	7,331	0	0	w 4,106	(f)	f 77,197	14,275	539	104	92,115	112
	T 10	T 191,768	0	0	769,467	2,058	771,525	k 72	7,909	57,800	15,864	689,880	(f)	f 75,702	63,824	536,914	2,497	0	10,943	(f)	10,472	123,246	24,959	6,426	1,897	167,000	113
	14	T 167,946	0	0	672,731	20,936	693,667	0	k 6,087	103,813	12,620	571,147	22,832	92,366	101,762	308,158	8,488	11,932	25,609	10,472	123,246	24,959	6,426	1,897	167,000	113	
	9	96,940	0	0	580,222	23,633	603,855	0	(v)	v 129,236	82,069	392,550	w 8,807	68,510	74,571	190,249	7,220	16,681	26,512	w 11,130	104,195	21,096	2,889	2,134	141,444	114	
	15	40,770	3	65,968	147,473	377,282	524,755	0	6,582	83,969	73,019	361,185	7,447	44,709	56,965	228,985	l 18,289	4,790	0	10,869	59,421	17,250	806	1,610	89,956	115	
	1	138,000	0	0	508,685	0	508,685	34,439	4,931	43,704	101,634	323,977	0	65,360	104,751	115,812	12,540	0	25,514	0	96,780	14,735	1,330	590	113,435	116	
	9	96,876	0	0	439,331	58,522	497,853	0	0	101,509	20,438	375,906	2,977	62,628	y 90,003	z 183,094	6,835	5,070	25,299	2,825	78,798	y 13,361	z 1,290	862	97,136	117	
	2	113,750	0	0	355,866	0	355,866	0	3,684	38,156	0	314,026	354	75,073	135,779	44,294	7,054	26,484	24,988	246	81,107	9,232	993	432	92,010	118	
	29	69,003	5	15,000	301,190	35,350	336,540	0	24,019	63,146	20,638	228,737	8,228	47,454	69,000	92,316	2,559	0	9,180	5,898	55,564	19,104	1,070	397	82,033	119	
Co.	9	54,515	0	0	260,272	60,606	320,878	0	5,643	40,367	19,699	255,169	414	53,088	90,470	90,093	4,093	9,211	7,800	368	66,236	15,097	100	462	82,263	120	
a	11	99,241	0	0	277,114	35,453	312,567	0	2,887	38,982	30,024	240,674	1,894	52,406	30,430	146,362	3,017	706	5,859	1,340	62,948	11,260	1,986	369	77,903	121	
	15	T 52,082	0	0	277,778	8,637	286,415	0	9,539	45,201	77,538	154,137	1,320	38,515	34,104	70,875	1,873	22	7,428	895	39,180	11,217	997	875	53,164	122	
ty	3	97,400	2	1,100	243,094	39,822	282,916	0	2,239	33,784	20,873	226,020	3,628	47,611	87,473	56,714	2,792	0	27,802	2,538	67,041	11,428	218	305	81,530	123	
	1	606	7	49,385	150,366	13,985	164,351	0	633	13,521	94,668	55,529	629	7,915	5,685	37,473	518	0	3,309	910	6,963	2,005	77	50	10,005	124	
	5	56,649	0	0	154,727	2,598	157,325	4,157	1,399	16,467	11,838	123,464	2,721	22,988	25,010	59,359	1,048	0	12,338	1,578	21,213	3,428	111	121	26,451	125	
	4	53,096	0	0	148,543	38	148,581	0	343	9,093	3,934	135,211	328	1,984	3,817	128,949	76	0	57	236	2,829	1,157	43	14	4,279	126	
o. (D)	8	36,321	2	488	29,329	73,553	102,882	0	3,889	12,450	10,806	75,737	2,347	14,879	22,107	27,205	1,774	0	7,425	2,601	18,627	4,419	1,676	39	27,362	127	
	159	1,657,947	19	131,941	6,767,453	871,504	7,638,957	38,668	86,491	958,660	1,058,192	5,496,946	71,415	908,914	1,210,633	2,867,596	92,810	79,790	265,788	57,957	1,131,787	220,876	21,748	11,876	1,444,244		
ain States																											
er Dam	0	0	1	704,800	3,072,604	0	3,072,604	0	17,176	18,604	3,030,219	6,605	0	3,210	1,843	0	0	0	1,552	0	605	81	0	2	688	128	
	0	0	14	T 349,750	1,712,088	1,663	1,713,751	0	v 211,257	74,651	1,406,240	4,336	66,982	60,467	1,126,996	8,825	101,653	36,981	2,920	75,050	11,034	1,198	1,279	91,481	129		
	6	61,970	29	178,192	692,170	383,888	1,076,058	0	k 6,534	158,213	12,055	899,256	w 18,450	100,809	d 744,955	(d)	7,603	19,758	7,681	w 16,524	83,308	d 11,105	(d)	334	111,271	130	
	2	612	13	105,610	717,997	27,394	745,391	0	5,043	89,354	397,828	253,166	69,563	69,956	50,891	59,351	3,405	0	0	21,787	37,103	9,810	93	54	68,847	131	
	L 12	L 114,507	L 10	L 42,975	514,904	30,864	545,768	0	5,422	72,230	60,358	407,758	9,958	81,468	103,291	194,612	8,541	0	k 9,888	5,472	109,303	18,528	6,327	340	139,970	132	
Assn.	1	10,000	8	70,950	168,004	281,047	449,051	0	62,840	74,537	55,836	255,838	0	15,347	0	141,391	0	0	99,100	0	7,020	0	5	368	7,393	133	
r Co	2	43,000	0	0	162,320	17,927	180,247	0	0	26,847	1,998	151,402	4,115	28,102	24,696	83,043	2,380	1,827	7,239	915	26,072	3,966	118	189	31,260	134	
	23	230,089	75	1,452,277	7,040,087	742,783	7,782,870	0	118,618	651,042	3,632,945	3,380,265	106,422	365,874	986,143	1,605,393	30,754	123,238	162,441	47,618	338,461	54,524	7,741	2,566	450,910		
ates																											
, Ltd.	10	479,625	49	882,441	4,689,287	1,368,987	6,058,274	2,708	68,410	1,315,204	256,659	4,415,293	927,814	508,722	638,782	2,051,188	72,994	205,856	9,937	211,931	571,857	141,465	4,306	583	930,142	135	
Water & Power	L 4	L 399,000	L 24	L 576,020	3,590,755	63,641	3,654,396	0	0	723,215	397,888	2,533,293	421,101	357,666	245,663	1,127,263	43,309	228,723	109,568	43,018	433,195	61,816	24,537	4,900	567,466	136	
o.	3	187,500	6	440,605	1,884,172	9,895	1,894,067	0	11,111	286,801	54,196	1,541,959	0	390,414	802,893	269,291	63,950	0	15,411	0	a409,098	a 91,927	a 2,260	a 1,024	a504,309	137	
Co	3	94,500	12	193,190	1,202,704	42,922	1,245,626	0	13,851	272,240	33,619	925,916	11,808	254,224	245,250	352,004	5,582	39,695	17,353	1	179,759	23,997	615	271	204,643	138	
	0	0	12	203,534	1,112,013	104,258	1,216,271	0	41,064	169,060	177,299	828,848	14,222	138,349	119,938	506,051	6,673	39,534	4,081	11,828	61,421	10,191	568	93	84,101	139	
	3	90,000	7	93,465	546,585	296,372	842,957	0	2,314	133,925	7,024	699,694	52,752	133,780	126,684	298,875	13,449	48,543	25,611	40,973	83,986	14,232	301	1,151	140,643	140	
Co	1	15,000	12	100,080	624,475	18,594	643,069	0	4,191	91,114	372,859	174,905	12,328	62,462	32,127	65,810	1,595	0	583	3,438	27,204	6,778	102	85	37,607	141	
ing	1	30,000	4	219,256	592,683	17	592,700	0	15,548	104,273	113,155	359,724	0	137,060	70,283	84,737	18,403	25,233	24,008	0	80,150	8,786	3,050	1,196	93,182	142	
gr. Bureau	0	0	2	83,000	528,727	0	528,727	0	1,283	33,838	493,606	0	0	0	0	0	0	0	0	0	0	0	0	0	0	143	
	2	42,500	1	9,600	253,860	248,271	502,131	0	1,128	62,845	82,136	356,022	0	61,831	y 60,067	z 227,323	1,463	0	5,338	0	43,439	y 5,905	z 586	649	50,579	144	
ic Utilities	2	34,000	3	114,000	432,449	68,959	501,408	0	1,484	76,615	11,914	411,395	0	73,589	41,950	272,139	7,264	483	15,970	0	33,685	3,929	982	270	38,866	145	
c Corp	2	8,135	8	48,875	240,365	179,039	419,404	H 165	7,759	108,329	69,485	233,666	47,491	34,247	d 145,298	(d)	912	0	k 5,718	1,455	28,236	d 6,156	(d)	61	35,908	146	
on	0	0	1	140,400	374,176	440	374,616	0	0	20,057	259,393	95,166	0	0	0	95,166	0	0	0	0	0	0	2	0	2	147	
	1	99,000	0	0	290,946	35,014	325,960	0	3,860	40,958	2,092	279,050	44,620	56,478	61,835	86,930	6,654	15,054	7,479	17,054	69,722	14,570	148	131	101,625	148	
	1	10,000	10	21,967	156,758	165,125	321,883	0	4,799	65,643	20,929	230,512	15,920	82,439	124,168	0	3,383	1,708	2,894	17,268	54,076	14,784	0	207	86,335	149	
	0	0	2	45,800	227,045	8,060	235,105	0	0	406	234,699	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	
	L 16	15,111	7	6,686	59,791	154,395	214,186	0	k 3,031	32,771	7,674	170,710	746	69,011	25,961	72,089	2,903	0	0	284	50,668	8,990	2,835	70	62,847	151	
stricts	1	1,000	2	31,000	177,453	1,510	178,963	0	15,014	19,650	68,589	75,710	(P)	(P)	(P)	(P)	(P)	(P)	P 75,710	(P)	(P)	(P)	(P)	P 19,780	19,780	152	
h	1	27,000	0	0	169,521	−4,164	165,357	0	1,134	7,576	366	156,281	(f)	f 5,630	3,398	146,383	296	0	k 574	(f)	f 4,682	461	120	33	5,296	153	
	0	0	1	X 31,250	128,530	0	128,530	0	0	0	x 128,530	0	.. 0	0	0	0	0	0	0	0	0	0	0	0	0	154	
strict	0	0	1	15,000	104,003	0	104,003	0	0	0	104,003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	155	
	51	1,532,371	164	3,256,169	17,386,298	2,761,335	20,147,633	2,873	195,981	3,564,520	2,896,115	13,488,144	1,548,802	2,365,902	2,744,297	5,655,249	248,830	604,829	320,235	347,250	2,131,178	413,987	40,412	30,504	2,963,331		
a																											
sion of Ontario (g)	1	25,000	45	1,352,690	6,655,728	3,149,264	9,804,992	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	156	
o. & Subs. (D)	0	0	20	X 876,000	4,540,015	1,359,590	5,899,605	0	24,199	397,139	801,994	4,676,273	5,487	73,722	167,892	3,211,225	4,698	16,698	Q1,196,551	17,607	95,280	23,997	45	337	137,266	157	
r Cons. & Subs. (D)	1	20,000	5	586,020	3,004,133	988,917	3,993,050	H 48,505	0	195,548	1,363,664	2,385,333	2,062	150,027	192,822	1,890,448	16,456	133,518	0	2,427	226,392	36,450	5,963	24	271,256	158	
	1	6,750	17	534,608	3,075,088	3,004	3,078,092	0	0	42,277	1,679,272	1,356,543	w 1,038	12,607	y 9,659	z 1,324,560	1,391	3,586	l 3,702	w 2,944	19,132	y 4,187	z 274	130	26,667	159	
	0	0	1	420,000	2,445,446	199,734	2,645,180	0	0	31,750	776,327	1,837,103	0	0	0	1,837,103	0	0	0	0	0	0	4	0	4	160	
	0	0	1	200,000	1,631,294	0	1,631,294	0	0	45,045	99,586	1,486,663	0	186	6	0	0	0	1,486,471	0	17	1	0	1	19	161	
	1	X 12,000	3	X 251,100	776,465	7,019	783,484	0	0	84,013	39,329	660,142	0	108,006	47,131	273,112	1,742	32,709	197,442	0	25,030	5,172	1,590	28	31,820	162	
, Ltd.	0	0	9	94,375	477,522	265,308	742,830	0	8,784	49,359	0	684,687	0	33,319	24,673	625,075	1,620	0	0	0	21,487	4,336	59	18	25,900	163	
d. and Subs. (D) (g)	3	8,150	...	98,000	735,629	0	735,629	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	164	
ric System	T 1	T 11,000	2	111,000	584,568	19	584,587	0	(t)	84,292	7,665	492,630	0	205,103	29,537	U242,316	15,674	0	0	0	41,755	2,377	3,687	6	47,825	165	
y Co., Ltd. (M)	1	X 17,500	5	X 211,325	537,674	0	537,674	82,247	9,708	85,773	9,079	350,867	(f)	f 97,251	68,376	173,036	12,204	0	0	(f)	f 96,925	15,927	2,804	19	115,675	166	
	0	0	4	54,200	331,568	0	331,568	901	0	17,620	22,997	290,050	61	344	211	289,392	42	0	0	123	450	149	16	3	741	167	
td.	0	0	5	43,865	177,018	63,754	240,772	0	l 1,288	36,704	49,596	153,184	1,055	19,733	11,226	102,626	3,582	0	14,962	1,673	23,286	4,545	544	121	30,169	168	
o., Ltd.	1	4,000	2	12,200	90,325	133,821	224,146	0	(t)	.....	453	223,693	0	85,129	d 98,717	(d)	620	12,461	26,766	0	24,388	d 4,513	(d)	250	29,151	169	
ission	4	Z 374	14	Z 76,350	216,305	775	217,080	0	0	10,629	42,158	164,293	(f)	f 1,768	(f)	162,430	95	0	0	(f)	f 4,685	(f)	11	5	4,701	170	
	5	X 13,077	3	X 53,000	157,849	3,325	161,174	0	973	23,878	99,872	36,451	447	5,232	10,359	18,931	1,482	0	0	353	10,133	5,550	35	105	16,176	171	
d	1	10,000	2	17,000	104,231	4,124	108,355	0	1,591	12,131	125	94,508	0	33	0	0	0	0	94,475	0	69	0	0	14	83	172	
	16	94,701	93	3,541,043	18,149,501	3,029,390	21,178,891	131,653	46,543	1,116,158	4,992,117	14,892,420	10,150	792,460	660,609	10,150,254	59,606	198,972	3,020,369	25,127	589,029	107,204	15,032	1,061	737,453		
o																											
Ltd. and Subs. (D)	2	32,240	15	211,873	1,119,657	28,796	1,148,453	0	21,389	371,942	0	755,122	1,515	101,897	49,047	4,353	13,934	80,855	503,521	127	217,570	56,648	49	9,032	283,426	173	
Railroads																											
C. Transit System	3	610,000	0	0	1,815,098	484,929	2,300,027																				
	0	0	0	0	0	G 1,204,407	G 1,204,407																				
	0	0	0	0	0	591,545	591,545																				
o	0	0	0	0	0	325,533	325,533																				
o	0	0	0	0	0	253,862	253,862																				
	2	180,000	0	0	226,206	4,205	230,411																				
rtford R. R. Co.	1	43,000	0	0	104,732	74,795	179,527																				
o	3	41,885	0	0	97,014	43,183	140,197																				
	0	0	0	0	0	129,576	129,576																				
	1	40,000	0	0	120,869	0	120,869																				
	0	0	0	0	0	117,352	117,352																				
	1	74,000	L 2	L 16,000	80,923	B 35,593	116,516																				
& Pacific R. R. Co.	0	0	0	0	0	115,091	115,091																				
ilroads	11	988,885	2	16,000	2,444,842	3,380,071	5,824,913																				

SUMMARY OF GENERATOR RATING AND OUTPUT OF LARGE UTILITY SYSTEMS

Region	No. Cos. or System	Number of Generating Plants and Generator Rating — All Plants — Number	All Plants — Rating, Kw.	Fuel Plants — Number	Fuel Plants — Rating, Kw.	Hydro Plants — Number	Hydro Plants — Rating, Kw.	Energy Generated (Net) Thous. Kw.-Hr.	Rec'd by Purch. or Interchange Thous. Kw.-Hr.	Output Gen. and Purch. Thous. Kw.-Hr.
United States (g)	**155**	**1,717**	**35,584,122**	**810**	**24,858,949**	**907**	**10,725,173**	**130,933,103**	**17,253,166**	**148,186,269**
New England	18	203	2,553,973	47	1,743,337	156	810,636	8,152,190	1,870,538	10,022,728
Middle Atlantic	22	296	9,576,134	128	7,742,290	168	1,833,844	36,016,000	2,985,272	39,001,272
East North Central	28	297	8,505,620	133	7,919,148	164	586,472	31,628,898	2,190,650	33,819,548
West North Central	17	210	2,618,756	130	1,966,041	80	652,715	8,302,350	257,174	8,559,524
South Atlantic (g)	16	144	2,186,987	88	1,454,313	56	732,674	7,467,495	2,603,962	10,071,457
East South Central	8	76	1,881,858	51	613,413	25	1,268,445	8,172,332	2,969,948	11,142,280
West South Central	18	178	1,789,888	159	1,657,947	19	131,941	6,767,453	871,504	7,638,957
Mountain	7	98	1,682,366	23	230,089	75	1,452,277	7,040,087	742,783	7,782,870
Pacific	21	215	4,788,540	51	1,532,371	164	3,256,169	17,386,298	2,761,335	20,147,633
Canada (g)	**17**	**109**	**3,635,744**	**16**	**94,701**	**93**	**3,541,043**	**18,149,501**	**3,029,390**	**21,178,891**
Mexico	**1**	**17**	**244,113**	**2**	**32,240**	**15**	**211,873**	**1,119,657**	**28,796**	**1,148,453**
Railways and Railroads	**13**	**13**	**1,004,885**	**11**	**988,885**	**2**	**16,000**	**2,444,842**	**3,380,071**	**5,824,913**

z Industrial.

A Estimated figures.

B Output of leased plants.

D Includes affiliated or subsidiary companies: Line 1 — New England Power and Massachusetts Utilities Assoc. (19) Includes Canadian Niagara Power. (23) Includes West Penn Power, Monongahela West Penn Public Service, Potomac Edison. (29) Includes Pennsylvania Electric, Erie Lighting, Solar Electric, Logan Light, Heat & Power, Associated Maryland Electric Power, Clarion River Power, Youghiogheny Hydro-Electric. (41) Includes Commonwealth Edison, Public Service of Northern Illinois, Western United Gas & Electric, Illinois Northern Utilities, Chicago District Electric Generating Corp. (47) Comprising Wisconsin Electric Power, Wisconsin Gas & Electric, Wisconsin Michigan Power. (55) Subsidiary Menominee and Marinette Light & Traction. (77) Includes Iowa Power & Light. (127) Texas and New Mexico districts.

G Purchased: PRR 992,235 LIRR 212,172

H No-charge energy entered in this column for convenience. Line 35 — Includes 225 furnished without charge.

L Line 132 — Includes two Diesel plants, 2,482; two leased hydro, 3,600. (136) Includes one leased internal combustion, 24,250; two leased hydro, 166,800. (151) Excluding Coos Bay steam plant leased to California-Oregon Power. (185) Leased.

M Mainland system only.

O Gross.

P Cols. 15–20 combined; also cols. 22–26 combined.

Q Electric boilers.

T Line 73 — Includes 250 internal combustion standby. (97) Actual capacity limited by boilers to 12,500. (112) Includes 7 standby plants, 17,420. (113) Capable capacity, 163,496. (122) Effective capacity, 61,780. (129) Capability. (165) Standby.

U Off-peak. Line 165 — Includes 139,946 off-peak.

X Kva.

Z Hp.